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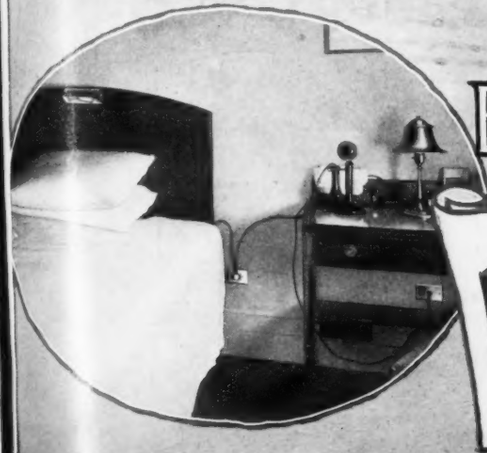

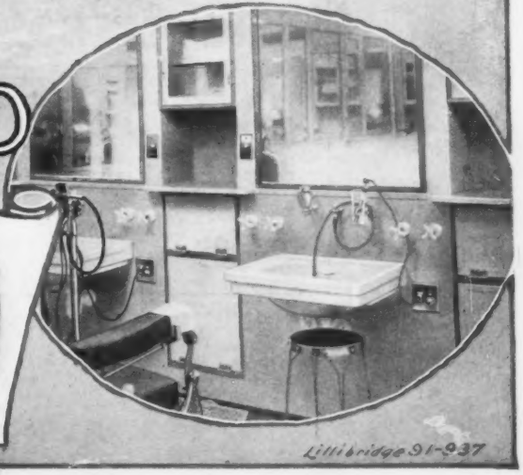

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Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 73 New York, Saturday, March 1, 1919 *Number* 9

Desirable Locations for Institute Conventions

THE large attendance at the midwinter convention of the American Institute of Electrical Engineers at New York last week is a visible sign of the interest which engineers take in Institute affairs. It also indicates the desirability of giving thought to the matter of selecting accessible places with ample hotel facilities for meetings and conventions. There are many such cities besides the metropolis, magnetic and ideal as New York is, and we hold no brief for any of them. Mountains and wooded hills afford delightful recreation during the summer, but not all mountain resorts are accessible and not all possess ample. suitable and reasonably priced hotel accommodations. The Institute membership now approximates 10,000, and it is to the interest of the electrical industry in general and of the Institute in particular that conventions and meetings be well attended. Granted an excellent program, one way to assure a large gathering is to choose for a meeting place some locality convenient of access to a majority of the membership, an effort being made to change the place of meeting so as to accommodate the great geographical sections.

Who would have thought that daylight saving would be abhorrent to the farmer? Just as the public is anticipating turning back the hands of the clock, up bobs the tiller of the soil and threatens to kick the whole scheme into the discard. Alas and alack! Lighting companies unconsciously are making friends.

Need of Coal Storage

THE winter of 1918-1919 is almost gone. It passed without a severe strain on the coal reserves built up to meet abnormally severe conditions. Available facts seem to indicate that even the most severe weather and the greatest war demand could have been met successfully, because the plea for the storage of coal was heeded. Fortunately, the conditions that had to be met were not severe. It is to be hoped, however, that the present situation will not cause those who are thoughtless to discount the value of coal storage. Such neglect would be unwise, especially at this time when the miners are not working steadily and when coal production shows a rapid decline. Certainly, labor conditions in the coal fields as well as elsewhere are far from encouraging, and new and maybe more exacting labor agreements must be negotiated with the signing of the peace treaty. Therefore judicious coal storage, beginning now, is really worth considering.

New Branch of Electrical Engineering

MANY interesting papers dealing with electric welding problems and results were presented at a joint meeting of the American Institute of Electrical Engineers and the American Institute of Mining Engineers in New York last week. To be sure, electric welding work received great impetus during the war, because of the shipbuilding program of the nation, but, while that particular field is exceedingly promising, it by no means embraces all of the art. Moreover, the interest lately manifested in the subject would indicate the possibility of an entirely new branch of electrical engineering, with problems peculiarly its own and with engineers and workers specializing along electric welding lines. The American Institute of Electrical Engineers fortunately took an active interest in electric welding from the very outset, and many of its members were of inestimable value to the government, and particularly to the Shipping Board, in experimental and constructive electric welding work. Electric welding also played an important part in the fabrication of the famous Liberty motors for aëroplanes. It is to be hoped that the Institute will retain its grip and interest in the subject and offer every encouragement to investigators and specialists so as to foster the work as a part of its activities rather than have its devotees form a separate organization. The electrical industry has too many national bodies for its own good.

Conservation deals with the creation of effort, efficiency with its application, and together they symbolize the fundamental philosophy of our time, namely, that all energy and effort should be created in the most economical way and applied in the most useful manner. This means fuel conservation in coöperation with skillful technique in the administration of interconnected hydroelectric systems.

Interconnection a Reasonable Policy

IT IS pretty late in the day to set forth the advantages of interconnecting electrical supply systems in general. The results of this progressive policy speak for themselves in many parts of the country where a practical *modus vivendi* has been attained through intelligent coöperation among the producers, transmitters and distributers of electricity. Nevertheless, some excellent plans are lagging in circles which display a very limited comprehension of the opportunities immediately ahead, and this state of things ought not to be permitted to continue among reasonable men.

There is an idea in some quarters that interconnec-

tion involves heavy expenditures to realize the economic benefits latent in particular situations. This notion may arise from the publication of estimated costs of comprehensive interconnection programs over statewide areas, or it may hang over, so to speak, from experience with construction costs incurred in this or that department under war conditions. It is true that the projects realizing the largest annual savings throughout extended areas of country of the thickly settled type necessitate large outlays in order that the complete programs may be attained, but along with this condition we must not forget that returns can usually be derived from such projects even when they are but partly finished and that many interconnection schemes which will pay well involve the outlay of only trifling sums. Certainly there should be no holding back of meritorious schemes after it has been shown by sound engineering analyses that they will pay.

Jealousy of operating control is another factor which sometimes retards interconnection. Most of the plans which we have seen give little reason for this attitude. It is entirely feasible to draw contracts of intersystem arrangements and dealings under various operating circumstances that will leave nothing to chance and permit each organization concerned to retain its maximum independence. For convenience, it may be desirable in some cases to lodge operating authority at a central dispatching point, but a properly drawn contract will safeguard the interests of all concerned, define the limits of such control, and enable each party to the agreement to supply his customers with even more facility than in the older days of go-as-you-please, now-coal-now-water operation. Interconnection is a reasonable policy, when justified on engineering and economic grounds, and the spectacle of systems whose lines actually cross refusing to have anything to do with each other through imaginary fears of giving up their control over their affairs should be dismissed after a single conference among those who are meanwhile losing the benefits of such interrelations.

Interest in the post-war convention of the National Electric Light Association will be keen. This will be a meeting for laying some foundation stones for future central-station development. Everybody get ready, please.

Wave-Shape Standards

IN THE early days of alternating-current distribution for electric lighting no particular attention was paid to the shape of the wave of electromotive force produced in the alternators. So far as incandescent lamps were concerned it made no difference. When alternating-current motors began to appear it was found that they worked most efficiently on smooth sine waves of emf. Ever since that time the designers of alternators have aimed at generating a smooth sine wave of emf. under all conditions. The standardization rules of the American Institute of Electrical Engineers in recent years have indicated the desirability of securing sinusoidal waves.

Meanwhile, telephone circuits were spreading and ramifying in all directions on the one hand, while alternating current lighting and power systems were spreading their networks broadcast on the other. Wherever these two systems came into mutual proximity they began to interfere. The telephone circuits hampered the power-transmission lines when broken-down telephone wires fell across the high-pressure power wires, and the alternating-current power-transmission circuits hampered the telephone circuits by inducing noisy disturbances in them, often making conversation by their means impossible.

In the valuable paper recently presented by Dr. Harold S. Osborne before the A. I. E. E. midwinter convention a large number of experimental measurements are reported, made in various ways, as to the relative disturbing effect, in a simple telephone receiving circuit, of a given value of superposed alternating current over a wide range of adjustable frequency. It is shown that the telephonic disturbance has a sharp maximum in the neighborhood of 1100 cycles per second, which is also approximately the resonant frequency of many standard telephone receivers. Above and below this resonant frequency the disturbing effect falls off rapidly, but it is still very appreciable even down to 200 cycles per second.

The ingenious plan was adopted of making an alternating-current measuring instrument which would measure the effective value of any alternating impressed emf. the harmonic components of which were automatically intensified substantially in accordance with the ordinates of the observed disturbance curve. The instrument is read first without any weighing of harmonics, like an ordinary alternating-current voltmeter, and then with the harmonics weighted. The ratio of the latter to the former reading then gives a telephone interference factor for the particular emf. wave tested. Numerous tests of alternators with the instrument are tabulated, showing interference factors ranging from 5 up to 543, with an average value reaching approximately 100.

The inference is that, while the amount of telephonic disturbance actually produced in any given case depends upon the physical conditions of the two systems, such as how near the wires approach, how far they run parallel, how great the voltages and currents are in the power system, yet, other things being equal, those alternators which generate a high interference factor, when tested in this manner, are correspondingly to be dreaded by the telephone engineers.

While it would be desirable for all alternators to have the ideal telephone interference factor of unity, if that were possible, it is impracticable to construct them in that way at the present time. It would mean that they had no harmonics or upper frequency ripples. Nevertheless, the paper will be very serviceable to electrical engineers at large by drawing attention to the real electrical conditions involved in the problem of non-interference and in appealing to alternator designers to aim as nearly as they can for a pure sine wave.

The only hope of solving the non-interference problem practically is to have coöperation between the power engineers and the telephone engineers, so that they may treat the matter as a joint effort and not in a spirit of mutual hostility. If the power interests and the telephone interests will join hands to keep the telephonic peace between them, the engineers can be trusted to find a *modus vivendi*.

Radio Apparatus for Artillery Fire Control

ONE of the most important and extensive uses of radio apparatus in the war has been the maintenance of communication between flying aëroplane observers and the allied artillery officers of the ground, whereby the artillery fire can be regulated and directed. It has been aptly said that in this war "the guns have aimed on what they did not shoot and have shot at what they could not see." However, with the aid of the eyes of an observer in an aëroplane this difficulty has been more than overcome. What will strike the reader of Capt. G. Francis Gray and First Lieut. John W. Reed's article in this number is the simplicity and portability of the radio apparatus which has been used for artillery regulation of aëroplanes. A very real difficulty with such aëroplane radio sets is the danger of interference. With a number of aëroplanes scattered along the flying front it becomes very easy to receive messages from the wrong observer and so introduce confusion into the communication system. This difficulty has been practically overcome by the use of five selective spark frequencies and also nine selective wave lengths.

The description of the apparatus in detail will be very interesting to all who are familiar with radio systems. For example, the use of a flame-proof key is something that in ordinary station sets would not be considered necessary but which in the air, with gasoline vapors present in possibly dangerous proportions, is a necessary element of safety.

The interesting story at the end of the article leads one to hope that a collection of such events may be made before the men who have taken part in this service have all been scattered. There is a fascination and adventure in radio communication under war conditions that ordinary radio service is unable to supply, and many thrilling tales of victories won and disasters averted can doubtless be told by those who practiced it.

Edison's fame is not lessened but strengthened by the passing years. It is made greater by his steady devotion to work. With strong purpose and untiring industry he has pushed on from one accomplished aim to the call of a new vision.

Cost of Hydroelectric Power

THERE have been many estimates made in past years of the general and specific costs of hydroelectric developments. These estimates represent various stages of the growth of the art. Most of them have had direct reference to some particular plant and are therefore only roughly applicable to other localities. By far the most complete report of the economic side of the hydroelectric situation as of the present time is that made to the Maine Public Utilities Commission by H. K. Barrows of Boston, the features of which are presented in the article beginning on page 413 in this issue of the ELECTRICAL WORLD.

It appears from the report that under conditions similar to those of the State of Maine hydroelectric energy with storage regulation can be delivered on the average as primary power at the end of a long transmission line at a cost of about 0.6 cent per kilowatt-hour. Mr. Barrows estimates that the cost of electric power generated by steam at tidewater would be slightly more than double this amount, which may be correct for the locality considered, but is certainly very high for the cost of generation in really large modern stations under moderately favorable conditions. Our own impression is that the case here made out for hydroelectric development is in general rather too favorable. It is only very rarely that a water-power plant can be given adequate storage for anything like its full utilization without running into local conditions which mean considerable increase in cost. And, further, an actual load factor of even 50 per cent requires time and favoring circumstances for its development. In addition, it can generally be secured only in operation on a very large scale with a distributing network sufficient to insure the full advantage of a favoring diversity factor.

What the conditions of costs will be in the next few years nobody can safely predict. The construction costs for hydroelectric work cited in the report would to-day be very much greater than the figures given, and so too would be the costs of a steam plant of similar capacity. The smaller amount of labor involved in the conduct of a hydroelectric system is a factor which is likely to work for some little time to come in its favor, but, on the other hand, the tendency now is greatly to decrease the cost of labor per kilowatt-hour in steam plants by the more extensive use of automatic machinery and the employment of bigger units, much bigger and hence relatively cheaper than anything available to the ordinary hydraulic plant.

The tendency now and henceforward is toward the installation of very large plants with networks commensurate with their capacity, and the general strategy of the situation will be to utilize the great water powers which can be developed in a relatively inexpensive way in combination with steam stations of very large capacity erected at favorable points. As between these the costs of power generation are very much more nearly alike than the figures here noted would indicate. There is, however, a good opportunity for working out locally combinations of hydraulic plants which can be developed at moderate cost even if of no great size. These can serve an immensely useful purpose either for near-by industries or as casual feeders to the bigger networks from time to time established. The fact of the matter is that, while averages form an interesting guide for a general view of things in hydroelectric matters, each situation must be judged on a somewhat exhaustive study of things as they are.

To meet world competition under peace conditions we must retain and practice the economies learned under the compulsion of war necessities. Fuel saving must be continued, although service may now safely be expanded. Coal or oil consumed per unit of output tells the story. While the war was at its height plant economies were chiefly gained by improving the use of existing equipment, but to-day there is a great opportunity to realize still broader gains in efficiency through the introduction of betterment equipment whenever conditions make this possible.

Radio Apparatus for Artillery Fire Control

Radio Apparatus Successfully Developed Through Co-operation Between Electrical Manufacturers and Signal Corps—Supply Alternator Is Driven by Air Fan Which Maintains Constant Frequency Through Wide Range of Airplane Speeds

BY CAPT. G. FRANCIS GRAY, SIGNAL CORPS, U. S. A., AND FIRST LIEUT. JOHN W. REED, SIGNAL CORPS, U. S. A.

THE most important and extensive use of radio apparatus by the army during the war was for directing artillery fire from airplanes. The system used for this purpose by all armies is essentially the same; the airplane circles over the target and the bursts of the shells are noted by the observer, who telegraphs a code message back to a receiving station near the battery.

When the United States entered the war and the Signal Corps began the development of new types of

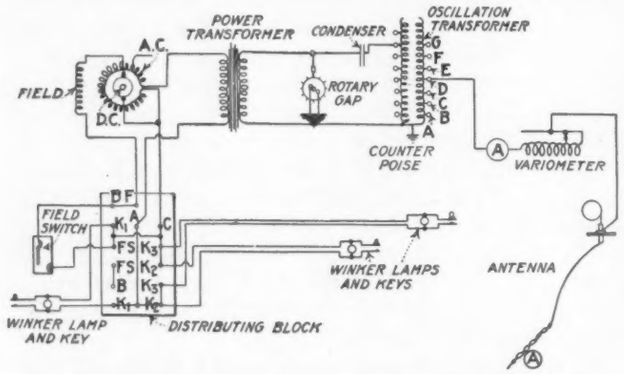


FIG. 1—CIRCUIT DIAGRAM OF AIRPLANE RADIO TELEGRAPH TRANSMITTING SET, TYPE SCR-73-A

apparatus to equip our expeditionary forces two general types of transmitting sets for this service were considered. For a limited part of the training work a very light battery-driven induction coil set was developed, but the design chosen for the majority of the work used an alternator mounted on the wing of the airplane and driven by an air fan as the source of power, the radio apparatus being of the synchronous gap type. This fan maintains fairly constant speed independent of velocity of airplane. In this article only the radio apparatus is dealt with. In both cases the receiving apparatus used a double tuned circuit and a crystal detector. The communication provided was entirely one-way, the air plane carrying a transmitting set only and the battery station having only the receiving set.

TRANSMITTING APPARATUS

In order to obtain the maximum possible speed of development and the best available apparatus, the advice and assistance of a number of manufacturers were obtained. The design arrived at has since required only very minor detail modifications. Reports from abroad indicate that the set is entirely satisfactory and compares favorably with any foreign set in use for the same service.

Circuit.—The circuit used is of the synchronous spark type and is shown in detail in Fig. 1. It is so well known as to need no comment.

Generator.—The generator is an inductor alternator, self-excited. Models were worked out by the Holtzer-Cabot Company, the Westinghouse Electric & Manufacturing Company and the Crocker-Wheeler Company. The Westinghouse design as finally put into production is shown in Fig. 3A. It has the following characteristics: Diameter, 6¼ in. (15.9 cm.); length of frame, 5⅜ in. (13.6 cm.); weight, 11 lb. (4.9 kg.); output, 335 volt-amp. at 94 volts, 900 cycles and 60 per cent power factor; excitation, 0.4 amp. at 45 volts; speed, 4500 r.p.m.

A particular requirement in designing this generator was that it should always build up when the field switch is closed. It was found that occasionally in shutting down the set the condenser discharged back and destroyed the residual magnetization of the machine. The comparatively low field voltage also led to occasional failures to build up due to brush resistance. Although the percentage of failures was small, it was considered advisable on the first lot of machines to provide a small dry battery with convenient switching arrangement for starting the excitation if needed. On the second lot of machines the use of higher field voltage, a damper winding around the field poles and the change from the simple alternating-current winding shown in Fig. 2 (left) to the split winding shown in detail in Fig. 2 (right), which prevents the demagnetization of the field mentioned above, entirely eliminated the failure to build up, and the dry battery was omitted.

Radio Apparatus.—The radio apparatus, with the exception of the antenna variometer, is mounted in the stream-line casing of the generator. The detail development work and the production of this material were handled principally by the International Radio Telegraph Company, and the resulting extremely simple

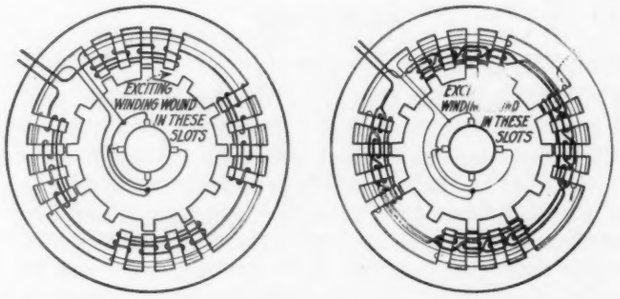


FIG. 2—WIRING OF INDUCTOR ALTERNATOR AS ORIGINALLY MADE (LEFT); METHOD OF PREVENTING DEMAGNETIZATION OF FIELD (RIGHT)

and ingenious design is due in great measure to its chief engineer, F. H. Kroger. The construction is shown in Fig. 3C. A number of spark wheels are provided, giving the following spark frequencies: 1800, 1275, 900, 600 and 450. Nine wave lengths are provided for, and

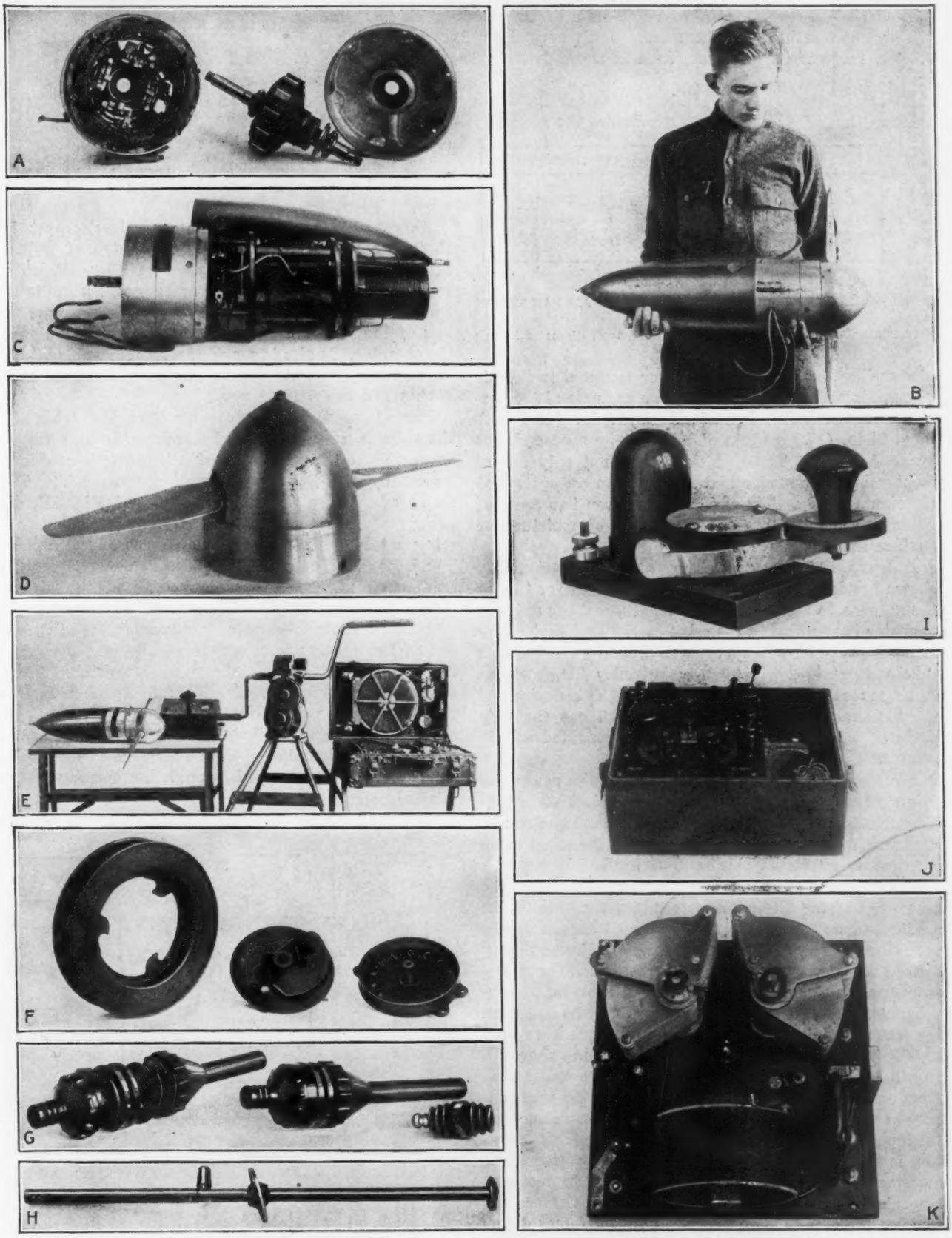


FIG. 3—RADIO EQUIPMENT USED BY THE AMERICAN EXPEDITIONARY FORCES

A—Inductor alternator, disassembled. B—Radio apparatus, generator and regulating air fan. C—Transmitting apparatus and alternator of the SCR-73-A set with stream-line casing removed to show construction of radio apparatus. D—Regulating air fan assembled. E—Comparison of SCR-73-A set with a land set of approximately the same rating. F—Antenna reel, type RL-2, disassembled. G—Low-voltage fairlead and fuselage bushing. H—High voltage fairlead. I—Airplane telegraph key, flame-proof construction, with winker lamp. J—Radio receiving set, type SCR-45-A (cover removed). K—Lower side of panel of radio receiving set, type SCR-54-A.

by varying the coupling it is possible to reduce the output current in several steps to a minimum of approximately one-fourth of the maximum. Under normal conditions the current in the antenna is approximately 2 amp.

Stream-Line Casing.—The stream-line casing, which incloses the radio apparatus and provides the necessary

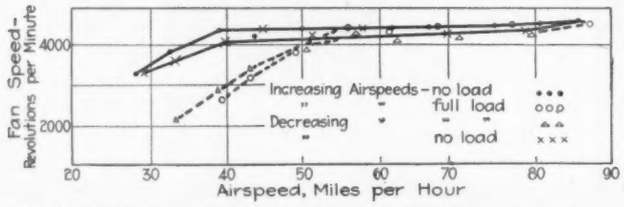


FIG. 4—CHARACTERISTIC CURVE OF REGULATING AIR FAN SHOWN IN FIG. 3D
(American Propeller & Manufacturing Company; diameter 20 in.; variable pitch)

stream-line shape for the generator mounted in the air stream, is particularly notable as an example of the possibilities of "duck micarta." It is 16 in. (40.6 cm.) long, 6¼ in. (15.9 cm.) in diameter at its open end, has walls $\frac{1}{16}$-in. (1.5 mm.) thick, and is not only an insulator but is stronger and lighter than an equivalent aluminum casing. The surfaces are given two coats of baking varnish to prevent absorption of moisture or surface leakage.

Antenna Variometer.—The antenna variometer, shown beside the air fan in Fig. 3E, is used for tuning the antenna to the proper wave length, and the antenna ammeter is mounted in the same case. This variometer is a simple helix of copper wire wound on a bakelite tube and provided with a suitable trolley for short-circuiting more or less of the inductance. This device and the keys, antenna reel and field switch are the only parts of the apparatus that must be mounted within reach of the operator.

Air Fan.—The air fan which supplies the power for driving the generator has been the subject of a considerable amount of development. The simplest form is, of course, a solid wooden fan. However, the speed of an airplane is quite variable, and a fixed-blade air fan varies its speed almost in direct proportion. Since the frequency of the alternator determines the note of the spark, and as this note is depended on to enable the receiving operator to read the signals through very serious interference, there was extreme need for a constant-speed air fan. An indication of the amount of development work done to meet this need may be had from the fact that more than 100 different designs have been tested by the Signal Corps, one of these being shown in Fig. 3D. The success of the work may be understood from consideration of Fig. 4, which shows the performance of the fan shown in Fig. 3D. In the more successful types of regulating air fans the principle of operation is to vary the pitch of the blades by means of the movement of weighted arms, which tend to move in response to centrifugal force and are restrained by springs, the resultant of the two opposing forces determining the angle of the fan blades with the line of flight, and consequently the ratio of air speed to speed of rotation. Details of this development will be described elsewhere in a later publication.

As an evidence of the compactness and light weight of this apparatus, Fig. 3E shows it in comparison with a set of approximately the same rating, the old army "pack set." The relative weights of these two for the corresponding parts shown are: Pack set, 156 lb. (70.7 kg.); SCR-73-A, 28 lb. (12.7 kg.).

Antenna System.—The antenna system on an airplane generally consists of a trailing wire having a maximum length of about 300 ft. (90 m.), the "ground" connection being furnished by the metal parts of the machine, which are all bonded together. Certain fittings and detail parts are required to handle this trailing wire.

Antenna Reel.—The antenna reel development led through a number of stages to the design of William Schramm of Philadelphia, shown in Fig. 3F. This reel has a simple centrifugal governor which limits the speed at which the antenna pays out and prevents the loss of the antenna due to carelessness on the part of the operator. It also is provided with removable bobbin, so that a spare antenna may be carried on an extra bobbin and installed if needed.

Floor Insulator.—The floor insulator through which the antenna wire passes, and at which the high-voltage connection to the radio apparatus is made, is commonly known by the British designation "fairlead." Two forms of this are shown in Fig. 3G and Fig. 3H, one being made entirely of molded material and the other of micarta tubing having a suitable flange molded in place. The importance of careful design in this insulator will be appreciated when it is understood that the high-frequency potential in this set may reach 30,000 volts.

Antenna Weight.—The antenna weight used at the end of the antenna wire was originally of the stream-line shape which gave it the name of "fish." It was made of lead and weighed 1¼ lb. (0.57 kg.). Later the use of a number of lead "beads" ½ in. (1.27 cm.) in diameter was substituted in order to permit of a new antenna being installed with the airplane in flight, the new weight being dropped through the opening in the fairlead.

Antenna Wire.—The antenna wire itself is a braided

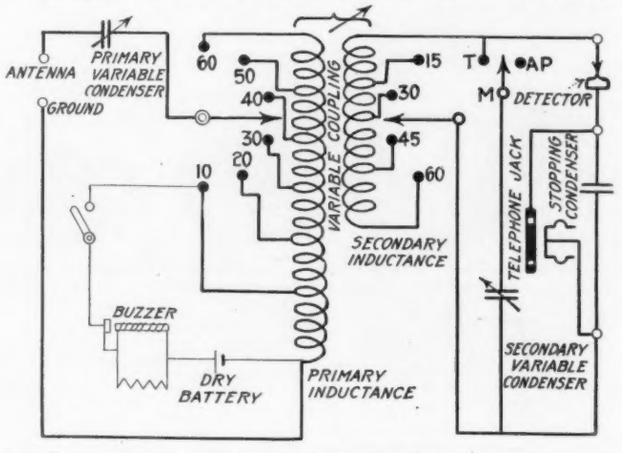


FIG. 5—CIRCUIT DIAGRAM OF RADIO TELEGRAPH RECEIVING SET, TYPE SCR-54-A

cable made up of sixteen strands of No. 30 B. & S. copper and having an average breaking strength of about 60 lb. (27 kg.).

Various auxiliaries to the set also required considerable development work.

Keys.—The keys (Fig. 3I), of which there are three for each set, are of flameproof construction and have

very heavy knobs and levers with fairly stiff springs, since they must be used by men wearing heavy gloves. This particular design was developed by the General Radio Company, and modified by the Signal Corps to include a small incandescent lamp connected in parallel with the contacts. If the set is in working order, this lamp glows when the key is not depressed, which in itself is a valuable indication. In addition, the lamp serves to indicate to the pilot when the observer is sending and vice versa, since all lamps wink when any key is closed. The various circuits are wired through a molded compound distributing box, and a toggle-joint switch is used for the field circuit. The official Signal Corps designation of this set is "airplane radio-telegraph transmitting set, type SCR-73-A."

The receiving set used with the transmitting set described above is generally installed in the neighborhood of its artillery battery, with which it is connected by wire telephone. In this exposed position it would often be undersirable to supply charged storage batteries (hence the use of vacuum-tube detectors and amplifiers was impracticable), and the set was designed to use crystal detectors, galena or silicon being generally specified. The circuit used is shown in Fig. 5, while Figs. 3J and 3K show the construction of the "set box." It is believed that these are self-explanatory, with the possible exception of the use of the buzzer, which is so connected as to excite the antenna circuit. This reacts on the calibrated secondary, so that the operator can adjust his set to listen for a signal of predetermined wave length without the use of a separate wave meter at each receiving station.

The exposed position occupied by these receiving stations makes the mechanical design of the antenna particularly important. It must be light, inconspicuous, easily erected in a short time and adaptable to a variety of surroundings and local conditions. In general the design used is a 60-deg. "V" composed of two wires 100 ft. (30 m.) long and mounted approximately 20 ft. (6 m.) from the ground. When trees or buildings are not available masts are required. After considerable experimenting the Signal Corps developed the mast

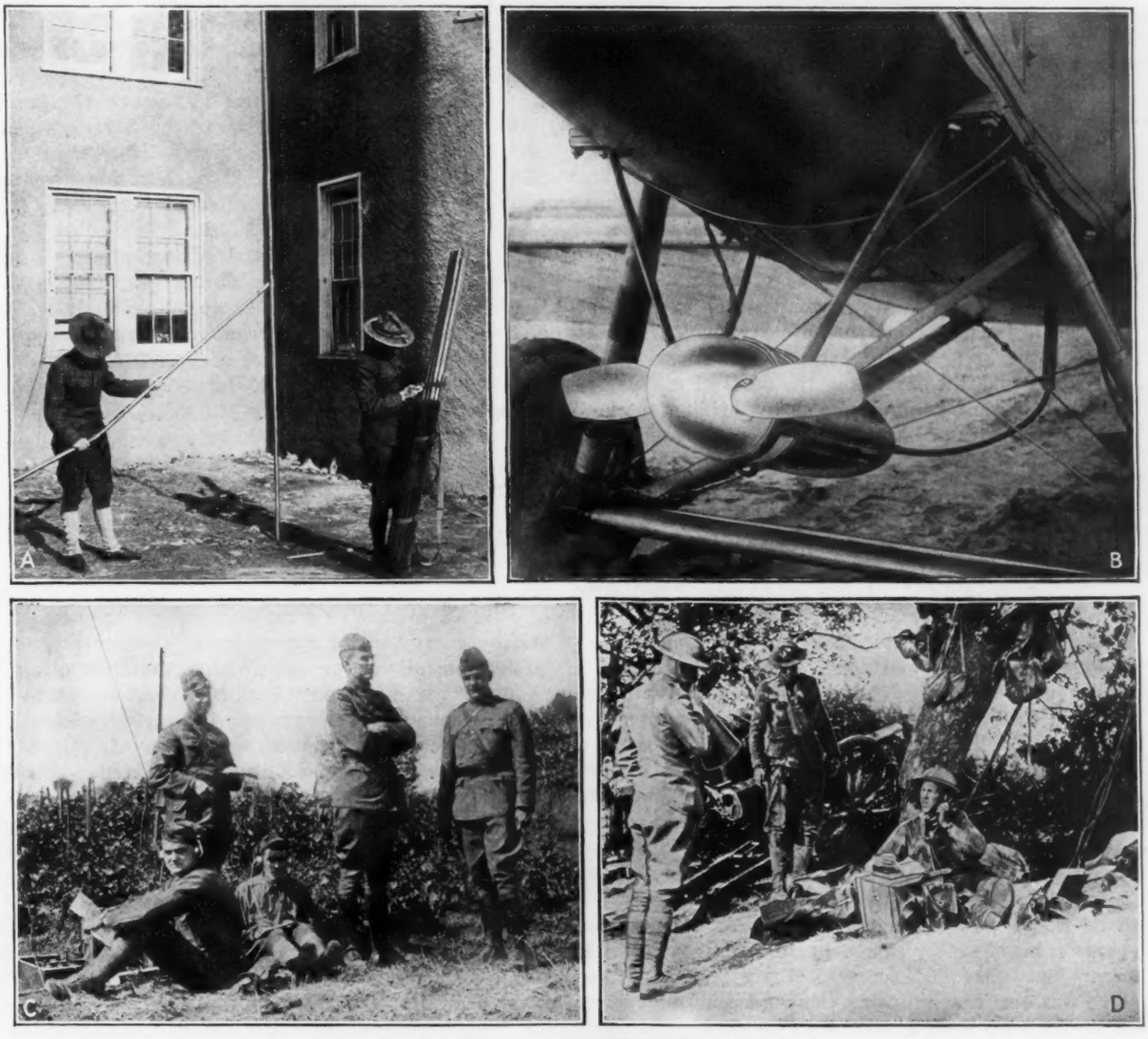


FIG. 6—VIEWS OF ACTIVITIES ON THE GROUND

A—Antenna mast, type MS-14. B—SCR-73-A set mounted on an airplane. C—Typical artillery receiving post. D—Artillery battery receiving telephone message from radio receiving station.

shown in Fig. 6A, made of spruce or pine wood, the sections being joined by a socket joint, slightly conical, the two parts being made of dissimilar metal to prevent rusting together. Simple strain insulators of bakelite material and light guy ropes were also provided.

The ground connection is made in a variety of ways depending on local conditions. Generally a woven copper mat in direct contact with the earth proved the most useful. In other cases insulated counterpoise wire was stretched along the ground, and in still other cases ground stakes were employed. Material for all of these was supplied with the sets.

The official designation for this receiving set is "radio receiving set, type SCR-54-A."

Fig. 6B shows the transmitting equipment mounted on the landing gear of an airplane, Fig. 6C shows a typical receiving post, and Fig. 6D shows a battery of auxiliary with the telephone operator receiving instructions from the radio receiving station.

Normal service for this combination requires a range of communication of at least 5 miles (8 km.). In field tests the sets here described have operated over 30 miles (48 km.), while with a vacuum-tube detector at the receiving station signals have been received from this transmitting set at 90 miles (145 km.) distance.

To the average person the romance of war lies altogether in the use rather than the development of such tools of the army as are here described, and if the story were told, the exploits of the users of radio apparatus would rank second to none in thrilling interest. It is not the purpose of this article to deal in such tales of heroism and adventure, but the following first-hand account of an every-day episode on the front may serve to visualize for the reader something of the conditions under which these sets were used. It happened during the period of the day when the receiving operator was not working with his own plane, but according to custom was "listening in" for anything he might hear.

This particular operator had been in school in Germany several years and could speak and understand the language very well. If the Germans sent down messages in their language, it was just as easy for him to take as English, and if in code he could translate it, since our intelligence department had all of their codes. He was "listening in" one evening about 6 o'clock, when he heard an enemy airplane send the message that he could see two divisions of our infantry filing into a certain wood and that the Germans should train all their guns on this wood, and the minute our forces were all in he would give the signal to fire. As soon as the operator heard this message he told his commanding officer just what had occurred, that the emeny machine was over him watching the woods, and that when all the infantry were in this wood he would send down the message to open fire on it. The officer as soon as he got the message telephoned to battalion headquarters and told exactly what was occurring. Some one from headquarters took the message to the infantry commander, telling him to get his men out as quickly as possible. Just as the last men were coming out the Germans opened fire with about 200 guns, and this stretch of woods was literally blown to pieces. If it had not been for the operator acting quickly, probably not twenty of the men would have come out alive. As it was there was not a single casualty.

PUBLIC OWNERSHIP DECRIED AT BOSTON

Arguments Advanced in Regard to Proposal to Make Appropriation for Investigation of Power Plant Centralization and Public Ownership

W. Rodman Peabody, counsel for the Turners Falls (Mass.) Power & Electric Company, spoke briefly against public ownership and operation of contral-station systems at a legislative hearing in Boston, Feb. 14, and predicted that the day of the small and inefficient electric station is doomed to yield to the superior economies of plants rated at around 100,000 kw., situated on the tidewater and transmitting energy to manufacturing districts over interconnected lines.

L. W. E. Kimball, for the Brotherhood of Electrical Workers, appeared on behalf of a bill to establish a state commission of light, heat and power, to investigate the power resources of Massachusetts and to assemble data bearing upon the public-ownership policy. Mr. Kimball favored public ownership in a general attack upon central-station rates as contrasted with municipal-plant rates.

Mr. Peabody, who was legal adviser of the Massachusetts Fuel Administration during the war and who has been identified with the Turners Falls hydroelectric and steam developments since their inauguration under the direction of Philip Cabot of Boston, said that he agreed with Mr. Kimball as to the necessity for securing the utmost possible efficiency in fuel utilization. The time is coming, Mr. Peabody stated, to look upon industrial districts like the Merrimac Valley as units from the power supply standpoint.

The speaker said that he believed that the policy of the State of Maine relative to the prohibition of water-power exportation would ultimately give way to one of interchange. It is no reflection on the policy or success of either a private or a municipal plant to cease generating energy and purchase at a lower cost from a large transmission or distributing organization supplied from a high-powered central plant or group of stations operated at maximum economy. The load of the steam locomotive, a notorious waster of fuel, seems likely in time to be taken over by the large electrical supply systems.

The mill owner of to-day, the speaker maintained, takes very little interest in his power plant. Every dollar which he spends on boilers and turbines brings him no direct result in earning additional revenue, as do spindles and looms. Central-station power is the coming thing. "Under public ownership," said he, "there is not the same inducement to keep a plant up to date as in privately managed power systems, and there is far more bravery in development, in extending industries, in risking capital, and far more ingenuity, far more Americanism, in putting plants into the hands of men whose life they are, subject to proper supervision, than there is in putting them into the hands of the public."

The hearing closed after a suggestion was made that the Gas and Electric Light Commission be requested to investigate power-plant centralization and public ownership data instead of appropriating perhaps $300,000 for a special light, heat and power commission as advocated in the Kimball bill.

Cost of Hydroelectric Development

Conclusions Based on Study of Maine Water Powers—Effect of Load Factor—Costs of Water Rights, Power, Transmission Lines, Storage Reservoirs—Comparative Utility of Hydraulic and Steam Power

COMPREHENSIVE data on the economics of hydroelectric development were given in a report by H. K. Barrows, consulting engineer, Boston, to the Maine Public Utilities Commission recently. Brief reference was made to this water-power report in the ELECTRICAL WORLD of Jan. 18, page 120, and some of the more interesting and significant facts and conclusions are set forth in the following paragraphs.

From the investigations made during the past few months fairly complete data of the cost of water-power and storage development are available for the Kennebec, Penobscot, Presumpscott, Union, Androscoggin and Saco Rivers (the last two in the State of Maine only). On these rivers over 700,000 hp. is available, about 55 per cent being at developed sites. To develop the remaining power will cost about $32,000,000, at an average outlay of about $99 per horsepower. More than half this undeveloped power is on the Kennebec River.

Increased storage amounting to over 81,000,000,000 cu.ft. (2,300,000,000 cu.m.), at a cost of about $2,700,000, would regulate to a high degree the flow of these rivers at comparatively low cost. Hydroelectric energy with storage regulation can be produced on these rivers and transmitted long distances (to tidewater if in large units) at a cost ranging from about 0.4 cent. to 0.9 cent and averaging about 0.6 cent per kilowatt-hour of primary power at the substation of a transmission line. About 20 per cent of additional power in excess of the primary power would also be available in an average year.

COST OF STEAM-ELECTRIC POWER

The cost of steam-electric power in good-sized stations adjacent to tidewater would be about 1.25 cents per kilowatt-hour at the switchboard, depending considerably upon the future costs of coal and labor. There is in general a considerable margin of cost in favor of hydroelectric power, provided sufficiently large developments to warrant transmission cost can be made.

In the light of present-day methods, the earlier water-power developments in New England were not made to give the best results as regards power utilization at low cost. Much space was required for canals, and the number of wheels required for the complete development was in many cases very large. Thus, there are something more than 155 water turbines used at Holyoke, Mass., while at Millinocket, Me., ten turbines develop a power about one-half as large. Many of these older developments would be reconstructed if it were not for practical difficulties involved by multiple ownership and the existence of many long-time or perpetual leases of water made in the past by the power companies to mill owners. Undoubtedly the time will come when the urgent need of power will bring about reconstruction. The large modern units now made by half a dozen leading American companies are without superiors in the world, and wheel efficiencies exceeding 90 per cent have become quite common. The maximum size of unit is constantly being exceeded, the limit at present being about 30,000 hp. Even in moderate-head plants the wheel-shaft efficiency has reached 93 per cent, whereas formerly 75 to 80 per cent was obtained.

COST OF WATER POWER

General Factors Affecting Cost of Construction.—The first cost of a hydroelectric plant is likely to be greater per horsepower than that of the steam electric plant, although with favorable natural opportunities for water-power development this may not be true.

Where fall is well concentrated and conditions of flowage permit, the simplest and most economical method of development is to build a dam with the power house at one end (or sometimes in the dam itself), simply utilizing the fall developed by the dam. For heads up to the vicinity of 30 ft. (10 m.) such developments can be made with the turbines placed in open wheel pits. Above this amount of head the cost of the bulkhead walls is likely to be such that a more economical development is made by bringing the water through short penstocks (or pipes under pressure) to the wheels. Frequently natural conditions are such that it is more economical to carry the water in a canal or closed penstock for some distance along the river below the dam, rather than to obtain the full fall by means of the dam. This is likely to be the case where there are limitations to the height of the dam on account of resulting damage due to flowage.

For a large stream (perhaps for quantities of flow in excess of 500 cu.ft. or 600 cu.ft. (14 or 17 cu.m.) per second) it is usually more economical to use a canal, for the necessary size of penstock required increases quite rapidly with the quantity of water to be carried and the cost of very large penstocks is relatively much greater than for smaller ones.

With large rivers, however, it is often desirable on account of the topography of the river banks to carry the water the greater part of the distance in a canal with small slope, and then for a short distance in penstocks (usually one for each wheel unit) which drop rapidly from the canal level at its end or "forebay" to the wheel units at the level of the power house.

Obviously the general items which will most affect the cost of a water-power development are those of the dam and waterways. Where natural conditions are such that these features of the development can be made at low cost, the resulting total cost of development will be low, as in general the other features (power house and equipment) will vary in cost within a comparatively narrow range.

As will be noted by reference to Table VI, the average total cost per horsepower of plants at developed sites in the State of Maine is about $114. This is the roughly estimated reconstruction cost of hydroelectric plants at the various sites where power has been developed and

is based on the development having the flow available 60 per cent of the time after regulation, with 100 per cent load factor.

The estimates made of the cost of constructing plants at undeveloped power sites, which are also summarized in Table VI, show an average cost for the four principal

TABLE I—EFFECT OF LOAD FACTOR ON COST OF HYDROELECTRIC PLANTS

Cost of Plant to Deliver 1 Hp. on Wheel Shaft with Different Load Factors								
			80 per Cent	50 per Cent	30 per Cent	Per Cent Increase in Cost Over That for 100 per Cent L. F.		
100 per Cent Load Factor			L. F.	L. F.	L. F.			
Equipment and Power House, Etc.	Other Costs	Total Cost	Total Cost	Total Cost	Total Cost	80 per Cent L.F.	50 per Cent L.F.	30 per Cent L. F.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$40	$210	$250	$260	$290	$343	4.0	16.0	37.3
40	160	200	210	240	293	5.0	20.0	46.5
25	175	200	206	225	258	3.1	12.5	29.1
30	70	100	108	130	170	8.0	30.0	70.0
25	35	60	66	85	118	10.4	41.6	97.2
20	40	60	65	80	107	8.3	33.3	77.7

rivers of $99 per horsepower on the same general basis as that previously stated. The average cost of all plants—both developed and undeveloped—is $107 per horsepower.

The cost of individual plants will vary very greatly from these figures—from about $60 per horsepower as a minimum up to $250 or more where sites are not especially good or conditions of development difficult. These are pre-war costs. Present costs would be probably more than double these figures.

Effect of Load Factor.—To indicate the general extent to which load factor affects the first cost of plant, Table I has been prepared.

In the table referred to the two approximate extremes in cost of development in the State of Maine have been assumed, with the usual variation in cost of equipment and power house. In a general way a power development which costs $200 to $250 per horsepower to develop is likely to be on a large stream tending to a moderate or low-head development, under which condition the cost of equipment and power house is likely to be at a maximum, as well as the features of construction. For this case, therefore, the range in cost of equipment and power house has been taken from $25 to $40 per wheel horsepower.

Similarly, a low cost of development at $60 per horsepower is likely to be a high-head development with usually a moderate amount of water. This tends toward lower cost of equipment and power house, and the range here has been assumed to be from $20 to $25 per horsepower, on the basis of 100 per cent load factor.

The cost per horsepower of wheel rating of hydroelectric plants will be less as the load factor decreases, as the increase in cost of plant with lower load factor is offset because of the greater relative increase in wheel capacity.

The variation in total cost with load factor is, as would be expected, much greater where the cost of the plant is low, as the variable factor of cost of equipment and power house is a much greater percentage of the total cost.

Cost of Water Rights.—The determination of the value of water rights is fundamentally a question of engineering, taking into consideration cost or feasibility of development as well as proximity to market. Their value should not be a matter of mere speculation, as has often appeared to be the case.

On the basis of development upon a 60 per cent flow basis and 100 per cent load factor, used in estimating the cost of development for the various rivers in the State of Maine, the approximate range in cost of water rights, including land, is $10 to $40 per horsepower.

Cost of Power.—Fixed charges on the cost of a water-power development, or the basis for annual cost of power, constitute approximately 10 per cent of the construction cost, the variation being about as follows: Interest, 5-6 per cent; depreciation, 2-3 per cent; taxes and insurance, 1-2 per cent.

Operating charges, the principal items of which are wages and repairs, are low. These will naturally vary materially with the capacity of the station and with load factor. They will usually be 0.1 cent or less per kilowatt-hour of power delivered at the switchboard for good-sized hydroelectric plants with a load factor of approximately 50 per cent. Assuming annual fixed charges at 10 per cent and twenty-four-hour, 365-day operation, the figures in Table II are obtained.

A hydroelectric plant on the rivers considered would not deliver its full output for 40 per cent of the average year. The 95 per cent or primary output is from 70 to 80 per cent of the full output on these rivers, with the suggested storage regulation, so that only about 5 per cent less than the full output would result for the average year. Making this slight deduction and keeping in mind 50 to 60 per cent load factor, it is evident

TABLE II—FIXED CHARGES FOR HYDROELECTRIC PLANTS WITH VARYING COST OF PLANT AND LOAD FACTOR

Cost of Plant per Hp.		Fixed Charges in Cents per Kw.-Hr. of Output at Switchboard			
	Cost of Equipment	—Load Factor—			
Total Cost	and Power House	100 Per Cent	80 Per Cent.	50 Per Cent	30 Per Cent
$250	$40	0.41	0.43	0.48	0.56
200	40	0.33	0.35	0.40	0.48
200	25	0.33	0.34	0.37	0.43
100	30	0.16	0.18	0.21	0.28
60	25	0.10	0.11	0.14	0.19
60	20	0.10	0.11	0.13	0.18

that hydroelectric power can be delivered at the switchboard for from about 0.25 cent to 0.6 cent per kilowatt-hour, for the range of cost of developments found on the rivers discussed in this report.

COST OF TRANSMISSION LINES

The great amounts of undeveloped water power—particularly on the upper Kennebec and Penobscot—must be transmitted long distances to reach a market. The cost of transmission must, therefore, be included for comparison with steam or other power near or adjacent to the coast.

Table III, giving estimated transmission-line costs for different lengths of line, capacity, voltage, etc., has been prepared by Prof. Ralph G. Hudson of the Massachusetts Institute of Technology, an expert on this subject.

To estimate the cost of various transmission lines, a size of the line wire was selected in each case which

would give a minimum annual cost of operating the line; that is, the interest, depreciation and tax charge per year was made equal to the annual cost of the electric energy lost in the line wires. In all the calculations leading to the final estimates pre-war costs were assumed throughout.

The line voltage suggested for each of the typical transmission lines is high enough to make the power

TABLE III—ESTIMATED COST OF TRANSMISSION LINES

Distance, Miles	Capacity of Line, Kw.	Line Voltage	Number of Towers	Number of Wires per Tower	Total Cost per Mile
25	5,000	66,000	1	6	$3,500
25	10,000	66,000	1	6	5,000
25	20,000	66,000	1	6	7,000
50	10,000	66,000	1	6	5,000
50	25,000	66,000	2	6	10,000
50	50,000	100,000	2	6	14,000
75	50,000	100,000	2	6	14,000
75	100,000	150,000	2	6	20,000
100	100,000	150,000	2	6	20,000

lost in transmission comparatively small. Among all the cases cited in the estimates of first cost the power lost in heating the conductors will range from 2 to 4 per cent of the total power transmitted. In most of the lines the total cost will be divided equally between the cost of conductors and the cost of the towers, including erection and right-of-way. In the case of short low-power lines the total cost may be divided in the proportion of two-thirds for the towers and one-third for the conductors, while in the case of short high-power lines employing a single line of towers the total cost may be divided in the proportion of one-third for the towers and two-thirds for the conductors.

Annual operating cost of transmission lines (per cent of capital invested): Interest, 7; depreciation, 6; operation, maintenance and taxes, 12; total, 25.

Table V shows that power transmission at a cost of about 0.10 cent per kilowatt-hour or less is readily obtainable, also that power to be transmitted most economically over long distances must be in large

TABLE IV—COST OF RIVER CROSSINGS

Length, Feet	Capacity of Line, Kw.	Line Voltage	Number of Towers	Number of Wires per Tower	Total Cost per Crossing
500	20,000	66,000	1	6	$2,000
1000	50,000	100,000	2	6	16,000
2000	50,000	100,000	2	6	70,000

amounts. Thus, with a 50-mile (80-km.) line the cost per kilowatt-hour with a line of 50,000-kw. capacity is only about one-half that where the capacity is but 10,000 kw.

COST OF STORAGE RESERVOIRS

In Table VII are summarized costs of constructing storage reservoirs upon six of the rivers in the State of Maine. As will be noted, the average cost per 1,000,000 cu.ft. of storage capacity is about $33 ($1,200 for 1,000,000 cu.m.)—a low figure which reflects the unusually favorable opportunities for storage development to be found in this state.

Storage on the Presumpscott River has already been developed and the extremely low cost of $10.79 per 1,000,000 cu.ft. ($330 per 1,000,000 cu.m.) of capacity has been made possible by the great natural storage facilities of Sebago Lake.

The proposed storage reservoirs on the Union and Presumpscott Rivers are also unusually low in cost. The Saco River storage is relatively the most expensive, but even this is moderate in cost compared with storage reservoirs in other localities.

The principal item of cost of a storage reservoir is likely to be that of the dam, particularly if the reservoir site is in wild or forest land, as is frequently the case in the State of Maine. On the other hand, where farm lands or villages are affected or railroad locations require change, these items of cost may be a considerable proportion of the total.

Cost of Operation and Maintenance of Storage Reservoirs.—The cost of operation of storage includes the wages of men employed in operating gates and in general supervision, ordinary repairs and the cost of keeping records of the height of reservoir, flow from reservoir, etc., which require some engineering supervision.

TABLE V—ESTIMATED COST OF POWER TRANSMISSION

Length of Line, Miles	Capacity of Line, Kw.	Total Capital Cost of Line	Capital Cost per Kw. Transmitted (50 per Cent L. F. and 5 per Cent Losses)	Cost per Kw.-Hr. (with Annual Cost 25 per Cent of First Cost)
25	5,000	$87,500	37	0.10
25	10,000	125,000	26	0.08
25	20,000	175,000	18	0.05
50	10,000	250,000	53	0.15
50	25,000	500,000	42	0.12
50	50,000	700,000	29	0.08
75	50,000	1,050,000	44	0.13
75	100,000	1,500,000	32	0.09
100	100,000	2,000,000	42	0.12

The total annual cost would include also, of course, items covering interest on investment, taxes and insurance.

With permanent concrete construction the rate of depreciation is low. The fixed charges, including interest, depreciation, taxes and insurance, would be about 9 per cent per year, and usually a further allowance of 1 per cent would cover charges for operation and maintenance.

Through the courtesy of Walter H. Sawyer, consulting engineer, Lewiston, Me., data in regard to the cost of operation and maintenance of storage reservoirs on the upper Androscoggin River have been furnished. In the case of the Rangeley Lake system, with a total storage of about 18,500,000,000 cu.ft. (518,000,000 cu.m.) operating expenses and repairs for the period 1902-1913 inclusive average a little under $10,000 per year or about 52 cents per 1,000,000 cu.ft. ($18.50 per 1,000,000 cu.m.) of storage capacity. The total storage capacity in use from 1911 to 1913 was about 28,300,000,000 cu.ft. (775,000,000 cu.m.) and the average cost per 1,000,000 cu.ft. for these two years was about 97 cents.

It seems likely that an annual cost of operation and maintenance of 50 cents per 1,000,000 cu.ft. ($12.50 per 1,000,000 cu.m.) of capacity would be ample as regards normal conditions at storage reservoirs in the State of Maine.

Table VII shows strikingly the extremely low cost of increasing the primary power capacity of several Maine rivers by means of storage. To guarantee primary

power with steam auxiliary means for annual fixed charges alone at least $7.50 per horsepower of plant, or more than double the average annual cost of storage, including its operation. Furthermore, to operate the steam plant entails further heavy expense of labor, fuel, etc. In a few words, it is evident that, both as a commercial proposition and from the viewpoint of conservation, the development and operation of storage facilities on these rivers offer the best means of increasing and guaranteeing primary power.

From Table VIII it is evident that the additional power gained throughout the year by storage regulation will be large in amount and very low in cost.

The power available from 81,000,000,000 cu.ft. (2,290,000,000 cu.m.) of increased storage used through an average head of 469 ft. (143 m.) would be about 111,000 hp. per year. During the average year, as shown in Table VIII, the increase in power due to storage would be about 68,000 hp., or in other words, about 61 per cent of the full storage capacity would be used dur-

TABLE VI—SUMMARY OF COST OF DEVELOPED AND UNDEVELOPED WATER POWER

River	60 per Cent Hp. of Capacity After Storage Regulation: At Developed Sites	At Undeveloped Sites	At Both	Cost of Power: Developed: Per Hp.	Developed: Total	Undeveloped: Per Hp.	Undeveloped: Total	Total: Per Hp.	Total: Total
Presumpscott	16,770	0	16,770	$153	$2,561,000	....	.....	$153	$2,561,000
Union	6,530	0	6,530	51	334,000	....	.....	51	334,000
Kennebec	63,900	169,560	233,460	150	9,600,000	$100	$17,092,000	114	26,692,000
Androscoggin*	118,020	42,770	160,790	120	14,200,000	134	5,730,000	124	19,930,000
Penobscot	158,310	94,560	252,870	(90)	(14.200,000)	76	7,150,000	84	21,350,000
Saco*	30,070	17,070	47,140	130	3,900,000	116	1,978,000	125	5,878,000
Total or weighted average	393,600	323,960	717,560	$114	$44,795,000	$99	$31,950,000	$107	$76,745,000

TABLE VII—COST OF INCREASED HORSEPOWER CAPACITY 95 PER CENT OF AVERAGE YEAR DUE TO STORAGE REGULATION

River	Increased Storage, Million Cu.Ft.	Total Cost of Increased Storage	Increase in Hp. Capacity, 95 per Cent of Average Year Due to Storage Regulation: At Developed Sites	At Undeveloped Sites	At Both	Total Cost of Increased Storage per Increased Hp. Capacity: At Developed Sites	At Undeveloped Sites	At Both	Annual Cost of Increased Storage, Including Operation, Fixed Charges, Etc.: Total Annual Cost	Per Increased Hp. Capacity: At Developed Sites	At Undeveloped Sites	At Both
Presumpscott	14,000	$151,000	10,650	0	10,650	$14.10	.....	$14.10	$15,100	$1.41	.....	$1.41
Union	9,150	136,000	2,920	0	2,920	46.50	.....	46.50	13,600	4.65	.....	4.65
Kennebec	17,060	802,000	27,050	58,490	85,540	29.70	$13.70	9.40	80,200	2.97	$1.37	.94
Androscoggin*	7,550	200,000	8,590	2.340	10,930	23.30	85.50	18.30	20,000	2.33	8.55	1.83
Penobscot	22,630	447,000	17,220	20,280	37,500	25.90	22.00	11.90	44,700	2.59	2.20	1.19
Saco*	10,720	957,000	12,400	7,980	20,380	77.00	120.00	47.00	95,700	7.70	12.00	4.70
Total or weighted average	81,110	$2,693,000	78,830	89,090	167,920	$34.20	$30.20	$16.00	$269,300	$3.42	$3.02	$1.60

TABLE VIII—COST OF INCREASE IN HORSEPOWER-YEARS DUE TO STORAGE REGULATION

River	Increased Storage, Million Cu.Ft.	Total Cost of Increased Storage	Increase in Hp.-Years for Average Year Due to Storage Regulation: At Developed Sites	At Undeveloped Sites	At Both	Total Cost of Increased Storage per Hp.-Year of Increased Energy: At Developed Sites	At Undeveloped Sites	At Both	Annual Cost of Increased Storage, Including Operation, Fixed Charges, Etc.: Total Annual Cost	Per Hp. Year of Increased Energy: At Developed Sites	At Undeveloped Sites	At Both
Presumpscott	14,000	$151,000	3,350	.....	3,350	$45.00	.....	$45.00	$15,100	$4.50	.....	$4.50
Union	9,150	136,000	900	.....	900	151.00	.....	151.00	13,600	15.10	.....	15.10
Kennebec	17,060	802,000	9,300	21,800	31,100	86.00	$38.50	25.80	80,200	8.60	$3.68	2.58
Androscoggin*	7,550	200,000	2,920	800	3,720	68.50	250.00	53.80	20,000	6.85	25.00	5.38
Penobscot	22,630	447,000	11,070	11,220	22,290	40.50	39.80	20.00	44,700	4.05	3.98	2.00
Saco*	10,720	957,000	4,250	2,540	6,790	225.00	377.00	141.00	95,700	22.50	37.70	14.10
Total or weighted average	81,110	$2,693,000	31,790	36,360	68,150	$84.80	$74.10	$39.50	$269,300	$8.48	$7.41	$3.95

TABLE IX—COST OF INCREASED STORAGE PER MILLION CUBIC FEET PER FOOT OF FALL

River	Increased Storage, Million Cu.Ft.	Total Cost of Increased Storage	Average (Weighted) Head for Storage Use: At Developed Sites, Ft.	At Undeveloped Sites, Ft.	At Both, Ft.	Cost of Increased Storage Per M. C. F. per Ft. of Fall: Per Million Cu.Ft.	At Developed Sites	At Undeveloped Sites	At Both
Presumpscott	14,000	$151,000	250	...	250	$10.79	$0.04	.....	$0.04
Union	9,150	136,000	78	...	78	14.85	.19	.....	.19
Kennebec	17,060	802,000	185	666	851	47.00	.25	$0.07	.06
Androscoggin*	7,550	200,000	427	213	640	53.60	.13	.25	.08
Penobscot	22,630	447,000	211	284	495	19.70	.09	.07	.04
Saco*	10,720	957,000	202	105	307	95.70	.47	.91	.31
Total or weighted average	81,110	$2,693,000	216	253	469	$33.20	$0.153	$0.131	$0.071

* In the State of Maine only.

ing the average year. This percentage of storage utilized would vary, of course, with the individual rivers; it would vary also with the percentage of flow used as a basis for development. The figure of 61 per cent represents a general average.

The cost of storage per horsepower of hydraulic plant capacity after regulation is also an item of interest. For the six rivers considered in Table VI the 60 per cent power after regulation will be about 394,000 hp. at developed plants and 717,000 hp. after complete power development. The first cost of storage per horsepower of capacity would therefore be about $6.85 for developed plants and $3.75 per horsepower if assessed upon the entire available fall.

The annual cost of storage, including operation, on this basis would be about $0.68 per horsepower for developed plants and $0.38 per horsepower for the entire fall. Expressed per kilowatt-hour of total plant output this is less than 0.01 cent—a very small cost.

COMPARATIVE UTILITY OF HYDRAULIC AND STEAM POWER

Power from a steam-electric plant in the State of Maine adjacent to tidewater, with no transmission costs, is likely to cost 1¼ cents per kilowatt-hour—with perhaps a little reduction from this figure for large plants. Hydroelectric power can be delivered at the switchboard for from 0.2 cent to 0.6 cent per kilowatt-hour and about 0.3 cent for the average-cost plant. Transmission costs from interior points to tidewater will add 0.10 cent per kilowatt-hour, making a range of cost of from 0.3 cent to 0.7 cent per kilowatt-hour and 0.4 cent for the average plant. However, the steam-electric power will be primary power, while the primary water power will be from 70 to 80 per cent of the full plant capacity (with 100 per cent load factor), assuming storage regulation. (The average cost of increased storage and its regulation, apportioned evenly among developed plants, is very small, as previously explained, although on individual rivers, like the Saco and Union, this would add perceptibly to the cost of hydraulic power.) Even considering primary power alone, which omits from consideration about 20 per cent of the water power really available, the cost of water power per kilowatt-hour will vary between about 0.5 cent and 0.95 cent (about 0.55 cent for the average-cost plant), as compared with steam-electric power costing (with very favorable future costs of fuel and wages assumed) from, say, 1 cent to 1.25 cents per kilowatt-hour.

There is one additional factor not yet discussed which would in general tend to increase the relative cost of hydroelectric power, as compared with steam, viz., the including in annual costs of a fair return upon investment, in addition to that assumed, of 6 per cent. In other words, instead of assuming 10 per cent and 12 per cent respectively for annual fixed charges for water and steam plants, these should, to take allowance of investment considerations, be, say, 17 per cent and 18 per cent respectively (allowing 1 per cent greater in this added factor for water power, on account of the greater risks involved).

With low-cost hydroelectric plants, costing no more than steam-electric plants, this would not change the relative costs of power—in fact, it would slightly favor the hydraulic plant. With the more costly hydraulic developments—those say of over $200 per horsepower (which are relatively few in number on the six rivers considered) the inclusion of this added factor of cost would result, as a rule, in little or no advantage for hydraulic as compared with steam power.

So far, no administrative or overhead charges have been included in the cost comparison of hydraulic and steam power. These must, of course, be considered in determining retail costs of power, but do not affect this economical comparison, as they are costs common to either type of power development.

Keeping in mind the low average cost of developments, in the vicinity of $100 per horsepower, on these rivers and the large amount of available power, there appears to be a very considerable margin in favor of hydraulic power. With an opportunity to use this power in sufficient amounts, even carried long distances, it would be cheaper than steam power, unless the latter was essential for process use.

To make transmission low in cost large units must be developed, however. Regulation by increased storage is also a fundamental requisite.

NEW POWER PLANT ON THE SAN JOAQUIN RIVER

San Joaquin Light & Power Corporation to Spend Immediately $1,750,000 to Construct Another Station of 20,000-Hp. Capacity

A. G. Wishon, general manager of the San Joaquin Light & Power Corporation, has announced the immediate expenditure of $1,750,000 for the construction of another large power house on the San Joaquin River. The new plant will have an output of 20,000 hp., and work is being rushed to complete it within one year from present date. The new power house will be known as San Joaquin Plant No. 6. It will be situated on the main San Joaquin River near what is known as Macy Flat, about 6 miles below the present big power house.

The new project comprises several unique features. A diversion dam 70 ft. in height will be erected across the river about 2 miles below the present power house. The water for the new plant will be taken from the river at this point and carried to a point 375 ft. above the power-house site, where it will be dropped through a pipe line 800 ft. in length to the generating machinery in the power house. To carry the water on this journey, more than 4½ miles of tunnels and conduit will be built.

The first work to be undertaken will be the tunnel work. A huge 400-lb. air compressor will be erected at the upper end, and by the aid of the latest improved air-driven tunneling machinery the big hole will be driven through the mountains. As the débris and crushed rock is carried out of the tunnel, it will be used in building up the big diversion dam. This dam will be 100 ft. long on the base and 450 ft. across.

To carry in supplies and equipment, the old road through Auberry Valley via Wellbarn will be reconstructed and will be extended 5 miles to reach the scene of operation. A new road will then be built from this site over the mountain pass connecting with the present Auberry road near the San Joaquin bridge at No. 1 power house.

Improving Relations of Employer and Employee

Ways to Bring About a Closer and Better Relationship Between Employees and the Industry Are Discussed by Richard H. Rice, Acting Manager of the Lynn Works of the General Electric Company

It is clearly recognized in the industry that friendly cooperation between employee and employer is essential to a solution of their common problems. How the two can be helped to appreciate their joint interest in the settlement of these problems is discussed by Mr. Rice in this interview with a representative of the ELECTRICAL WORLD. Ways and means of keeping a close contact between the men and the management are outlined, and Mr. Rice recognizes the importance of creating peaceful industrial conditions. These are an essence of prosperity and advancement.

"EVERY manager of an industry who brings about a closer and better relationship between his employees and his industry, who increases their effectiveness and knowledge, is doing his bit to help win the industrial victory necessary for America's prosperity," said Richard H. Rice, acting manager of the Lynn (Mass.) Works of the General Electric Company, in response to an inquiry by a representative of the ELECTRICAL WORLD relative to the advantages of the joint committee system of representation in the conduct of factory affairs.

LABOR THE GREAT QUESTION

"The great question to-day in the proper and successful management of an industry," said Mr. Rice, "is how to handle justly and fairly the labor which is an essential part of the industry, how to maintain production unimpaired, and how to keep the cost of the product at a reasonable figure. If America is to retain her position as an industrial nation in the years of reconstruction and post-reconstruction to come, she must be able to manufacture and export to foreign countries all those articles of commerce which her genius and inventive ability have produced and will produce under competitive conditions more severe than any which we have as yet known. She must be able to manufacture and market her products at home under similar competitive conditions. The industrial facilities existing in America to-day are so much more extensive than they ever have been that our home markets will no longer be sufficient to absorb our products.

"In 1913 electric motors were landed in New York from Italy and put on the market at prices which would barely pay the labor and material cost of similar motors made in this country. Although the world war stopped these importations, the tariff laws are unchanged and no reason exists why a similar situation will not arise in the future."

The utmost possible coöperation between employers and employees, therefore, is believed by Mr. Rice to be vital to the industrial success of the country under the conditions of world-wide competition in the post-war period.

Mr. Rice emphasized the difficulties of maintaining close personal relations with workmen in the great modern organizations as contrasted with the intimacies of twenty years ago and more. These relations are now in a transition stage brought about by the growth of industries. "Old methods of management are inadequate to-day," he said. "In many cases the good relationships formerly existing have broken down, and managements have suddenly awakened to the fact that a seemingly peaceful working force has been full of hidden discontent and of legitimate cause for complaint which the existing systems of management have failed to disclose and deal with. In the meantime, in other shops other methods have been in use, and these methods have been equally faulty. With the growth of trades unionism there has been a growth of shops dealing with these unions, and here also the system has failed to function properly."

In the trades-union shop the tendency is to magnify causes of dispute and even to manufacture differences. The whole tendency of such a relation is to cause separation between management and men, to pull apart, to dissociate instead of to coöperate. The output tends to be restricted, the efforts of able, industrious and loyal employees are hampered, and the full possibilities of team work can never be realized. Moreover, the chief weapon of trades unionism is the strike. This weapon completely disrupts good relationships, which can only be restored after the lapse of a considerable period.

"It is not my purpose to antagonize labor unions," said Mr. Rice, "or to propose any means for antagonizing them. I recognize the right of employees to join such unions, but I also recognize the right of employees to refrain from joining if they see fit. I am clear, however, that no means has been devised of dealing with the employees through labor unions which has shown any efficiency. It must be evident that it is impossible to deal effectively with outsiders in the settlement of questions relating to an industry because it is impossible that such outsiders should have any intimate knowledge of the questions with which they are dealing. It is equally impossible to secure best results when the parties in controversy have diverse interests and are not animated with the spirit of mutual interest and coöperative endeavor.

DISASTROUS LOSS FROM STRIKES

"During the period of the participation of this country in the great war the number of strikes occurring and the loss of production resulting therefrom was far larger than in any other period of our history, and this at a time when, if ever, 100 per cent production was needed to back up our troops, to feed them, and to transport them and their material to the front and to maintain them there. Does not this indicate a breakdown in the effectiveness of old methods of management? Only after a particularly disastrous strike was a plan devised and put into operation which abandons the objectionable methods of the past and really deals with large organizations in a proper and adequate way. This plan has been in operation for nearly four years with complete industrial peace where formerly such relations

were unknown, and with entire satisfaction to employees and to management. It does not affect, prevent or discriminate against membership in trade unions, and the unions have lately quoted the plants where this plan was first inaugurated as examples of good conditions

FEATURES OF THE PLAN

"The essentials of the plan are:

"(a) Establishment of representation of employees by representatives who are workers, elected by their fellows, by secret ballot, in such a way that complete representation is secured.

"(b) These representatives are empowered and encouraged to assist employees to present their cases to the management in an effective and thorough manner.

"(c) From these representatives are elected members to serve on joint committees with an equal number of representatives of the management. These joint committees serve as committees of appeal from the decisions of the foreman, try the facts and endeavor to reach an agreement.

"(d) These joint committees are chosen for the different parts of the plant or the different mines or mills of a large industry.

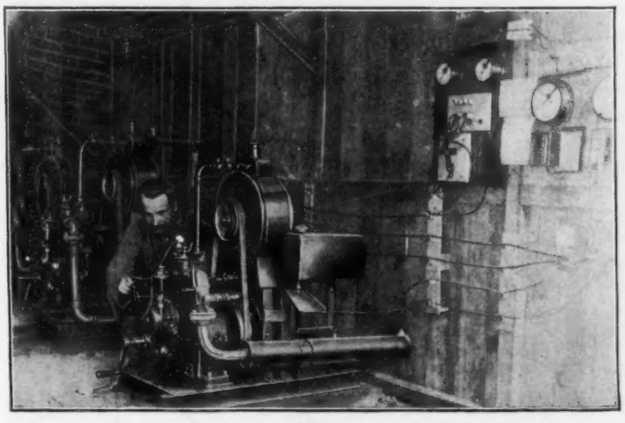
"A further joint committee, consisting of an equal number of employees and management members, constitutes an appeal committee for the entire plant. This committee brings a broader and a freer viewpoint to the consideration of the question. The head of the works or of the group of shops, mines or mills is the final resort to settle all major questions not disposed of by these means. Failing settlement by him, appeal must be had to arbitration. The president or manager of the works keeps in touch with all activities conducted under the plan by means of a special representative, whose chief duty is to see that all matters are promptly handled.

"Other joint committees are established which deal with matters having to do with plant economies, safety, sanitation, recreation, education, etc. By taking the representatives into partnership in these matters an esprit de corps, a coöperative relation for the general good, is built up which is invaluable. Through these joint committees one of the chief advantages of the plan may be realized, viz., education of the employee members of these committees in the needs, requirements and technicalities of the business, and through these members an education of the employees themselves may be secured which they would otherwise miss entirely. The employees find that many of the things with which they are dissatisfied are promptly remedied while others are more fanciful than real. They come to a better realization of managerial difficulties, learn the need of output, of a fair day's work for a fair day's pay; they get the spirit of the management and get 'in phase' with it. The foremen, on the other hand, learn to sympathize with the viewpoint of fair and loyal employees; they learn better methods of dealing to secure results, and learn not to be arbitrary but to be right. The management is in better touch with the spirit and atmosphere of the shop, and vice versa.

"The management of an industrial plant is a trustee responsible for the well-being of stockholders and employees, and has a real duty to the community, the prosperity of which, quite generally, depends largely upon the prosperity of the industry. To receive the support of the community, the stockholders must receive a proper return on their investment, and this investment must be built up and protected. The employees must be fairly compensated and cared for, healthy and reasonably contented. If the industries of the country had been well managed in past years in both these directions and if the managements had convinced the communities of these facts, much of the bad legislation and much of the wild and dangerous political and social propaganda of past and present would have been spared us.

SET THE HOUSE IN ORDER

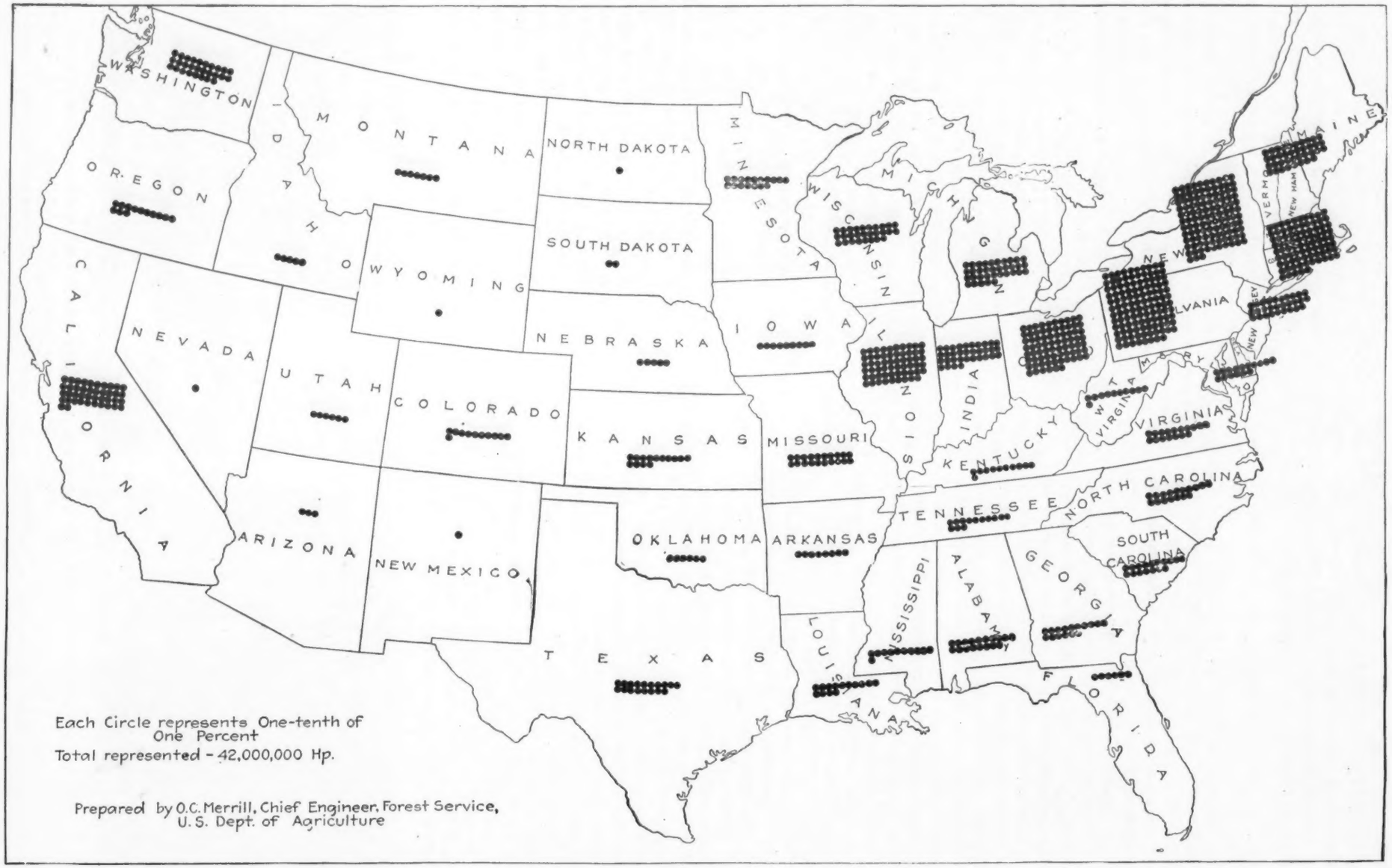
"Industrial agitation and discontent give rise to social agitation and discontent. The managers of industry owe it to the country to set their houses in order. By some such means of dealing fairly, promptly and effectively with all disputed questions, and of giving employees a voice in matters affecting their health, comfort and education, and of exhibiting to them frankly the problems of management and the needs of the business, industrial peace has been and can be secured, provided that a spirit of fairness and justice animates the management. I take it for granted that this will be a case, for any other spirit is sure to result in disaster."



THE UTMOST POSSIBLE CO-OPERATION BETWEEN EMPLOYERS AND EMPLOYEES IS VITAL TO INDUSTRIAL SUCCESS

"The great question . . . is how to handle justly and fairly the labor which is an essential part of the industry, how to maintain production unimpaired and how to keep the cost of the product at a reasonable figure."

"The foremen learn to sympathize with the viewpoint of fair and loyal employees; they learn better methods of dealing to secure results, and learn not to be arbitrary but to be right. The management is in better touch."



DISTRIBUTION OF PRIMARY POWER, WATER POWER, STEAM POWER AND GAS POWER, 1918

Primary power, which consists of the installed capacity of waterwheels, steam engines and gas engines in commercial and municipal central stations, street and electric railways and manufacturing plants, has been estimated for 1918 by assuming a rate of increase in each state from 1912 to 1918 corresponding to the rate of increase for such state from 1902 to 1912 as indicated by the data given in Table No. 4, Part II of Senate document No. 316, Sixty-fourth Congress, First Session. The figures do not include horsepower of locomotives.

Midwinter Convention of the A. I. E. E.

National Engineering Standardization, Electric Welding, Improvement of Insulations, Radio-Telephony and Electrophysical Subjects Hold Attention of New York Gathering

DESPITE the pressure on hotel accommodations in New York City which has existed for some time, many engineers attended the midwinter convention of the American Institute of Electrical Engineers held in that city on Wednesday, Thursday and Friday of last week. Great interest was evident in all the subjects which were under review, either from the large attendance or from the amount of participation in the discussion; but the sessions devoted to electric welding and the effect of entrapped air on the strength of solid insulations appeared to attract the most attention. Owing to the handicaps which have existed from the lack of engineering standards and because of the advantages which would obviously result from improvement of conditions, the method outlined by President C. A. Adams for establishing and operating a national standardization body was particularly well received. Scientific as well as popular interest was attached to the presentation of authoritative information regarding radio development during the war.

Features of the principal papers and discussions are presented in the following pages, these being grouped according to their general classification and not necessarily according to their order of presentation.

INTEREST OF ENGINEERS IN INDUSTRIAL STANDARDIZATION

Importance of Standardization Pointed Out—Machinery Proposed by American Engineering Standards Committee to Remedy Present Chaos

President C. A. Adams, in his convention address, "Engineering and Industrial Standardization," pointed out the efficiency and economy effected by careful standardization. The problem is not only national but is world-wide, and the purposes and organization of the American Engineering Standards Committee should be thoroughly understood. Professor Adams said in part:

"Most of us speak of standardization in a vague sort of way, not realizing that the coöperation without which our modern society would be impossible would in turn be impossible without a large measure of standardization. It might almost be said that the degree of standardization in any nation is a measure of its civilization, certainly in the material or industrial sense. . . .

"One of the most striking examples of standardization possibilities is the attempt only just made by one of our most progressive manufacturers of electrical machinery, a member of this Institute, to develop coöperative standard electric motor designs. Nine manufacturers are working together to this end. Consider the immense advantage to the consumer resulting from the general interchangeability of parts and the reduction in the number of spare parts carried by a user who has motors of several of these coöperating manufacturers. Moreover, the designs still contain the best features of all these makes, and there will still remain ample opportunity for competition in production cost and quality of workmanship."

The work of the standards committee of the A. I. E. E., Professor Adams said, "has placed competition on a far more equitable and generally satisfactory basis. It has encouraged more careful and thorough designing and a more careful selection of size on the part of the user, and generally has resulted in better machines. In certain fields, notably in standardization of types and in dimensional standardization when the latter is carried into complete designs, there is an obvious danger that standardization may develop into crystallization and serve as a brake on progress; but this is merely an obstacle and not an argument, since it is obviously possible to keep the standards abreast of progress."

In outlining the present machinery for national standardization, the speaker said: "The fields of the several engineering organizations overlap in large degree; there is much duplication of effort and confusion of result, and many of the standards promulgated are practically useless. Coöperation between two or more organizations has been tried, sometimes successfully, but there is no recognized machinery of coöperation, no standard procedure, and confusion still reigns. To meet this need there has been recently created an American Engineering Standards Committee."

This committee serves as an authoritative national body to deal with the corresponding foreign bodies and is made up as follows:

(a) The "main committee" (with three representatives from each of the five "founder societies" and three government departments), whose functions are chiefly those of an organizing, coördinating and steering committee.

(b) Sectional committees, one for each group of standards (with representatives from all organizations or government departments vitally interested in that particular group of standards), whose function is to prepare the standards in question under the direction of the most vitally interested organization, known as the "sponsor body."

(c) The "sponsor body" may be one of the founder societies, a government department or one of the "cooperating societies" or organizations.

(d) Under "coöperating societies" it is intended to include all organizations interested in the production of standards and willing to coöperate.

"The machinery," said Professor Adams, "thus provides for absolutely comprehensive coöperation, eliminates overlapping and duplication of effort, and yet does not undesirably restrict the initiative of the several coöperating societies. With proper support and the cooperation of all interested organizations, it should contribute largely to the industrial development of the country. Moreover, it should be a potent factor in promoting international standardization and commerce."

ELECTRIC WELDING

While intense interest in the subject of electric welding was indicated by the large attendance at the joint welding session of the A. I. M. E. and the A. I. E. E. on Wednesday, the volume of discussion was disappointingly meager for the number present. President C. A. Adams presided, opening the session by calling attention to the disappearing lines of demarkation between different branches of engineering and by referring to some of the work of the electric welding committee of the Emergency Fleet Corporation. Announcement was made of the organization of a national welding bureau which will be representative of all interests—manufacturers, users, engineering societies and government.

PATH FOLLOWED BY RUPTURE IN STEEL FUSION WELDS

Oxide Films at Grain Boundaries and Iron-Nitride Needles Possible Causes of Brittleness—Heat Treatment and Prevention of Oxides

From investigations made by S. W. Miller, the first evidence of strain in electric welds appears where visible defects may exist in the weld, such as film of oxide around the grains or around small particles of metal. Therefore, every effort should be made to avoid the formation of oxides. If there are no defects in the weld, the rupture is invariably along the grain boundaries. These conclusions apply to welds as made and not to those that have been heat-treated. Also, the path of rupture due to shock or alternating stress may possibly be different from that due to tensile stress.

Since all brittle welds resemble each other in having more or less columnar structures and containing such impurities as pearlite, cementite and nitride of iron, it is possible that quenching may help remedy the trouble since it produces an entirely different structure.

EFFICIENCY AND ECONOMY IN WELDING MILD STEEL

Pros and Cons of More Than Thirty Electric Welding Practices the Value of Which Is Open to Discussion

By stating both sides of questions concerning electric welding based on investigation of the welding research sub-committee of the welding committee of the Emergency Fleet Corporation, H. M. Hobart has opened the door for a discussion that in all probability will do much to extend knowledge of the subject. Some thirty-four controversial subjects are considered in his paper and comments pro and con are given. Some views which he sets forth follow:

Uniformity is very essential in welding electrodes, otherwise during welding an operator may come to bad places in the welding wire and the arc will probably sputter. However, if the electrodes are dipped in milk of lime (whitewash) good work can be done with electrodes that otherwise would be useless. While some claim that a thin covering obtained by dipping accomplishes the desired purpose, others contend that it is desirable to provide a covering designed so as to be consumed at a definite rate as compared with the rate of consumption of the inclosed welding wire. The welding committee recommends the following electrode composition: Carbon, not over 0.18 per cent; manganese, not over 0.55 per cent; phosphorus, not over 0.05 per cent; surphur, not over 0.05 per cent, and silicon, not over 0.08 per cent.

Experiences of specialists indicate that electric welding may be done as well with alternating current as with direct current. It is a little more difficult to hold the arc, but this simply resolves itself into a matter of practice. Alternating current for arc welding has been used with a frequency as low as 12½ cycles and as high as 500 cycles, and although there is no consensus of opinion on the correct frequency, it is known that the alternating arc can be held better at the higher value.

Some observers believe that alternating-current produces a more dense weld than direct current, whereas others refer to the fatiguing effect of attempting to hold an alternating-current arc and say that consequent frequent breaking of the arc produces bad spots in the weld. The power factor obtained with alternating-current welding leads to capital and operating costs offsetting any advantages, in the opinion of some authorities, but others are of the opinion that since, for ship welding on an extensive scale, motor-generators are required, power factor affects only the generator circuit and not the motor circuit. With thirty or forty outfits distributed fairly evenly on the different phases of a polyphase system, the load would be sufficiently balanced to be satisfactory, but this would correspond to an unusually large welding installation.

Where a number of arcs are to be used within a reasonable distance of each other the series system may be used. In this arrangement the secondary of an ordinary constant-current transformer supplies current to the primary of all the welding transformers in series. The individual transformers insulate the welding apparatus from the series circuit and transform from the series current to current of proper value for the arc. In this case the inherent reactance of the series transformer is low. The power factor of such a system can be safely made much higher than where individual arcs are operated in multiples from constant-potential circuits.

For spot welding plates from ⅜ in. to ¾ in. (9.6 mm. to 19.2 mm.) in thickness, the single-phase currents required would be from 30,000 amp. to 50,000 amp. and the kva. required at 60 cycles would range between 300 and 900 at power factors of from 0.35 to 0.50. These low power factors, combined with the fact that this load would be for short periods at very frequent intervals, would make it decidedly undesirable from the central-station standpoint. The condition would be much improved at 25 cycles, as the machine would operate with about half the kva. and about double the power factor.

Attention has been pertinaciously drawn to results of a very few tests which have appeared to indicate that metal-arc welds are inherently utterly deficient in ductility, yet the committee has had also before it the results of many well-authenticated tests of ductile metal-arc welds.

The comparative strengths of some joints follow:

	Ultimate Load lb.
Spot and fillet welded	50,350
Fillet welded	37,000
Riveted and fillet welded	35,000
Spot welded	28,000
Riveted joint	13,000

According to one American authority, "the present well-tried field for electric arc welding is confined entirely to welding plates and forms; a great deal of work has been done on plates ranging in thickness from $\frac{1}{16}$ in. (1.6 mm.) to $\frac{3}{4}$ in. (19 mm.). Up to $\frac{1}{8}$ in. (3.2 mm.) the costs of gas and electric welding are about the same; above this the electric process is less expensive.

By some authorities ductility is believed to be most readily obtained by employing flux-covered electrodes. On the other hand, the committee has knowledge of several kinds of bare electrodes of various compositions which, in competent hands, make reasonably ductile welds.

All sorts of values are given for the speed, in feet per hour, with which various types of joints can be welded. In general, and within reasonable limits, the speed of welding will increase considerably (25 to 35 per cent) when larger currents are employed. This increase is not directly proportional to the current employed because a greater proportion of time is taken to insert new electrodes and the operator is working under more strenuous conditions. Up to a certain point ductility and strength improve with increased current, but when these conditions are met the best speed is not obtained, owing to increased heating zone and size of weld puddle.

Using highly skilled welders, an average rate of welding of only 2 ft. (0.6 m.) per hour was required to do the best possible work, varying the kinds of joints made in one long test. The amount of electrodes used up was about 2.7 lb. (1.1 kg.) per hour, of which approximately 16.5 per cent was wasted as short ends and 13 per cent burned or vaporized, the remainder being deposited at the speed of 1.9 lb. (0.85 kg.) per hour.

Rates up to 7 ft. (2.1 m.) per hour have been obtained in practice, but from his observations the author is of the opinion that a representative rate for a good welder of half-inch plates is about 2 lb. (0.9 kg.) per hour.

The practice heretofore customary of stating the speed of welding in feet per hour has led to endless confusion as it depends on type of joint, height of welt and various details. A much better basis is to express the speed of welding in pounds of metal deposited per hour.

The welding research sub-committee considers that the preferable current for a double-V $\frac{1}{2}$-in. (1.27-cm.) weld is at least 200 amp. If the weld of the plate is of the double-bevel type, some 50 amp. less current should be used for the bottom layer than is used for the second layer if two layers are used. For $\frac{3}{4}$-in. (19-mm.) plates the most suitable welding current is some 300 amp. This is of the order of twice the current heretofore most usually employed for such a weld.

Investigations of the welding committee are indicating that at least 10,000 amp. to 12,000 amp. per square inch is suitable for electrodes of $\frac{1}{8}$ in. and $\frac{5}{32}$ in. (3.2 mm. and 4 mm.) diameter and well up toward 10,000 amp. per square inch for electrodes of $\frac{3}{16}$ in. and $\frac{1}{4}$ in. (4.8 mm. and 6.4 mm.) diameter.

Metal-arc welding is at present proving very attractive to engineers, but it is too early to return a verdict as to whether this widespread tendency toward metal-arc welding is based on sound premises or whether there ultimately may not be a reaction (for certain kinds of work) back to carbon-arc welding.

One company has long followed the practice of using a 30-deg. bevel for plate edgings and finds it satisfactory for all thicknesses up to $\frac{3}{4}$ in. (19 mm.). If the smaller angles give welds which are equally satisfactory in all respects, the decreased amount of electrode material required, the decreased consumption of electricity and the increased speed are advantages not to be overlooked. The tendency is toward the use of at least two layers for $\frac{1}{2}$-in. plates, and three layers for $\frac{3}{4}$-in. plate.

Obviously, the procedure for testing the original metal should follow standard practice as recommended by the American Society for Testing Materials, but there is considerable difference of opinion and uncertainty as just how and what mechanical tests should be made of the welded joint and of the deposited metal.

ELECTRIC WELDING IN CONSTRUCTION OF SHIPS

Economy Possible Through Replacement of Rivets —Reliable Welds Possible if Trained and Skilled Men Are Employed

The cost of ship construction must be reduced, says Commander S. V. Goodall of the British Admiralty, and a reduction in riveting is the most fruitful field for economy. The welding committee of the Emergency Fleet Corporation has found by actual experience that a labor saving of at least 60 per cent results from the substitution of arc welding for riveting on minor parts of a ship, and J. H. Anderton has estimated that a saving in time of 70 per cent was effected at Hog Island.

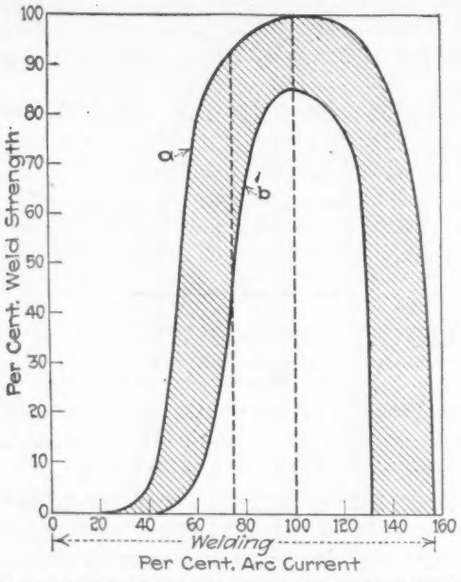
The best method of overcoming the difficulties ahead appears to be to build up a staff of thoroughly skilled welders, to gain experience by the adoption of welding on minor parts, to proceed cautiously in the extension of the process to more important members, not to expect a great saving in time and cost immediately, but to persevere, not necessarily toward the rivetless ship but toward a vessel in which the employment of both processes of riveting and welding is so adjusted that more riveting or more welding could only be done at greater cost.

It is strongly urged that steps should be taken at once to establish welding as a skilled trade and that only certified men should be employed. Skilled men working under an experienced foreman would know, for example, that clean surfaces are necessary for good work, they would quickly learn what types of joint are made with ease, in what portions of a ship welding is cheap or where it is unreliable, and from their ranks should be drawn the draftsmen who will design in detail the welded vessel of the future.

FUSION IN ARC WELDING EASILY DETERMINABLE

Indicated by Overlap of the Edge of the Deposit Layer on the Plate—Penetration Comparable to Depth of Arc Crater

After a study of the penetration, overlap and effect of arc length on fusion O. H. Eschholz has concluded that the fusion obtained in arc-welded joints between the plate and deposited metal is determined by the penetration of the deposit metal into the plate metal and the overlap of the edge of the deposit layer on the plate. These indications of the quality of a weld can be easily observed by visual inspection. The penetration is comparable to the depth of arc crater as observed by the welder when moving the arc terminal over the



VARIATION IN STRENGTH OF WELD TO BE EXPECTED WITH CURRENTS ABOVE OR BELOW NORMAL

plate with uniform velocity, and the overlap is indicated by the contour of the surface of the congealed deposit in the region adjacent to the material welded. For most welds a crater depression of $\frac{1}{16}$ in. (1.6 mm.) will give the desired penetration, while a contour which does not show a re-entrant angle between plate and deposit indicates an overlap per layer of approximately $\frac{1}{32}$ in. (0.8 mm.) or less.

Other observations made by Mr. Eschholz will be reported in a later issue.

Discussion on Electric Welding

Strength of electric welds and factors affecting their characteristics, such as kind of labor to employ, arc length and current strength, exclusion of contaminating influences of the air, etc., were the principal subjects discussed in the electric welding session.

President Adams declared that mild-steel welds had been made with a strength of 60,000 lb. per square inch (4218 kg. per sq.cm.), while armor plate welds have been produced having a strength of 75,000 to 85,000 lb. per square inch (5270 kg. to 6000 kg.). These results have not been consistently attained, but they indicate what can be done by controlling all influencing factors. Means have been developed whereby welds may be tested non-destructively in the laboratory with great accuracy, and it only remains to adapt the method to commercial use. Many specimens have broken outside the welds.

It is a mistake to employ ordinary labor for electric welding, H. A. Hornor contended, since the ordinary workman does not have the right temperament.

A. M. Candy referred to a decarbonizing effect on the parent metal of a weld apparently produced by using carbon electrodes. Considering metal electrodes, he pointed out that the surface tension of the molten electrode metal may have considerable effect on the contamination of the weld metal and arc current since this factor determines the size of the molten globules. Since hot-rolled steel electrodes produce weaker welds than some other metals which are apparently less desirable chemically, it seems that the chemical analysis is not much indication of the weld characteristics which will be obtained. The speaker warned against allowing a high open-circuit voltage when unskilled workmen are employed because of the long arc possible.

There will be a big field for electric welding where high-pressure steam pipes are used, said H. R. Woodrow, who pointed out that very successful results were obtained in one place where 200-ft. (61-m.) lengths made up of welded 10-ft. (3-m.) sections were lifted into place and tested for 600 lb. (42 kg.) pressure.

If speed of welding is an advantage, said C. J. Holslag, the alternating-current system is faster (33 per cent at 100 volts) than the direct-current system using a negative electrode. With the work negative the electrode melts too fast. Since the closer the electrode is to the work the less chance there is for impurities to enter, it is desirable to use a short arc, Mr. Holslag said. This also assures the metal being deposited in the crater with the least overlap. Metal penetration is reduced with low voltage, he contended, so reactance in series with resistance is desirable to secure the desired penetration.

W. L. Merrill disagreed with Mr. Hornor, saying that good welds can be secured with ordinary labor, provided that proper training is given. He pointed out that whereas spot welding could only be used successfully on plates up to $\frac{3}{4}$ in. (19 mm.) thick formerly, it is now possible to spot weld where the total thickness is 3 in. (7.5 cm.). Spot welding can be performed satisfactory under most conditions because very few variables enter. Since spot welds can be made stronger than the parent metal, the thickness of the latter can be reduced where it has been based on the strength of riveted joints.

D. C. Alexander contended that properly covered electrodes are essential, since the right vapor produced around the molten metal will protect the outside.

According to tests being made by the Electrical Testing Laboratories on samples of electric welds, there is no advantage to large beveling angles in butt-welded joints, said William Spraragen. Furthermore, the power, amount of metal and time required are excessive for large angles.

T. M. Hunter said that the efficiency of direct-current welding sets is not so high as many think, 12 per cent in some cases. With an alternating-current set higher efficiency is obtainable, and the power factor can be maintained around 38 to 50 per cent.

CALCULATION OF TRANSMISSION AND TELEPHONE LINES

FINDING THE DANGER ZONE OF LINE DISTURBANCES

Propagation of Steep Wave Fronts Along Transmission Lines Investigated Mathematically—Limiting Danger Zones at High Frequency

In his paper entitled "The General Equation of the Electric Circuit—III," Dr. C. P. Steinmetz undertook the investigation of transmission-line phenomena such as those due to lightning disturbances and circuit switching. Heretofore these problems have been attacked on the assumption that the circuit constants, resistance, inductance, capacitance and shunted conductance, are in fact constant. This assumption was shown by Dr. Steinmetz to be far from the truth when the equivalent frequency is extremely high. In the case of steep wave fronts r, L, C and g change rapidly "due to the unequal current distribution in the conductor and the finite velocity of the electric field." Rectangular waves are rounded off, and the attenuation is so great that dangerous conditions are confined to limited zones near the origin of the disturbances.

In grouping transmission-line problems for purposes of calculation Dr. Steinmetz shows that this classification depends upon the frequency. "Four successive stages may be distinguished in the expressions of the circuit constants as functions of the frequency: (1) Low frequencies, such as the machine frequencies of 25 and 60 cycles, where the resistance is the true ohmic resistance and the internal reactance and inductance those corresponding to uniform current density throughout the conductor, with conductors of moderate size and of non-magnetic material. (2) Frequencies of the magnitude of 1000 to 10,000 cycles, where the resistance and internal reactance or inductance are those due to unequal current distribution in the conductors; that is, the resistance is rapidly increasing and the internal inductance decreasing. The conductance, g, is still negligible, radiation effects still absent, and all the energy loss that of thermal resistance. (3) High frequencies of the magnitude of 100,000 to 1,000,000 cycles. The radiation resistance is appreciable and becomes the dominating factor in the energy dissipation. The internal inductance has practically disappeared. A considerable shunted conductance exists due to the dielectric radiation. (4) Extremely high frequencies, of the magnitude of many millions of cycles, when the quarter wave length has become of the magnitude or less than the distance of the return conductor. Radiation effects entirely dominate, and the usual expressions of inductance and of capacity cease to apply.

"Only when the frequencies which are of importance in the problem lie fairly within one of the four ranges above discussed is a general theoretical investigation possible at present."

Instances of industrial importance were considered as follows:

(1) The conduction of high-frequency currents such as produced by lightning and similar disturbances; (2) the attenuation of waves in overhead transmission circuits; (3) the rounding of rectangular waves; (4) the flattening of steep wave fronts. The body of the paper was devoted to the formulation of these four problems.

The author was highly complimented for his apparent successful formulation of the high-frequency phenomena. Professor Adams, Prof. C. F. Scott, C. R. Underhill, Dr. J. B. Whitehead and Dr. A. E. Kennelly took part in the discussion

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GENERAL EQUATIONS FOR ELECTRIC CIRCUITS

Account Is Taken of Transient Oscillations and Phenomena of the Steady State in Equations Developed for Transmission-Line Calculations

General equations for the calculation of current in any network whether of transient or steady character were presented by John R. Carson. In this paper the current is expressed in terms of two functions, the applied voltage and a characteristic function of the system which is independent of the form of the applied voltage. The function which depends only upon the system is called the "indicial admittance," indicating that it is an index of the system and completely determines the behavior of the system to all types of applied voltages.

In addition to the development of the general theory and formulas Mr. Carson devoted considerable effort to the derivation of fundamental solutions which admit of easy interpretation and computation for transmission lines having continuously distributed inductance, capacity, resistance and leakage.

Lack of time prevented any extended discussion of Mr. Carson's paper.

NEW WAVE-SHAPE STANDARD IS BEING WORKED OUT

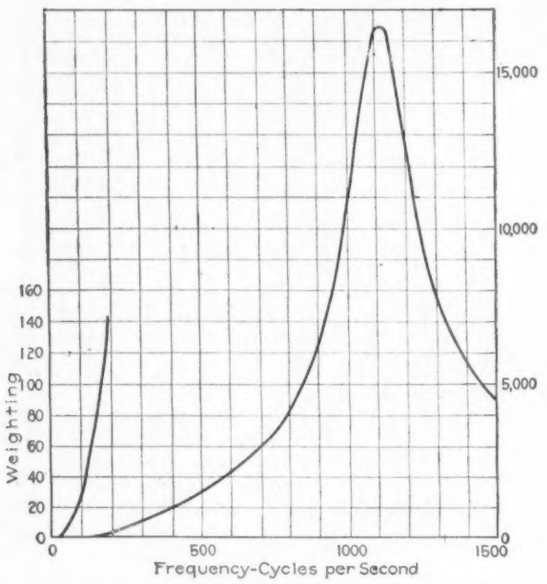
Telephone-Interference Factor Is Proposed for the Determination of Voltage Wave Forms—Instrument Developed to Test Alternator Waves

Until the past year the only standard of wave shape included in standardization rules of the American Institute of Electrical Engineers has been the rule that the maximum deviation from the equivalent sine wave should not exceed 10 per cent of the amplitude of the equivalent sine wave. It has been pointed out, however, that the deviation standard has marked disadvantages, and consequently the sub-committee on wave shape standard, as reported by Dr. Harold S. Osborne, continued the study of the effects of harmonics in voltage waves and their influence on operation. Few data were found to show the effects of these harmonics on the operation of power systems, but their inductive influence on telephone circuits has been under investigation for a number of years.

When telephone systems come within the inductive influence of power systems much trouble has been experienced, and this trouble bears a definite relation to the frequencies of the harmonics in the wave form. The committee therefore has collected experimental data regarding the relative effect of harmonics of different

frequencies in producing interference in telephone systems. It is proposed that the present deviation factor be retained for all alternators and that an additional factor be adopted to be applied to alternators which will be used on open-wire (that is, one which is not in cable) transmission and distribution systems. This additional factor is based entirely on the effect of the harmonics in producing interference in telephone circuits when the power and telephone circuits are parallel. No attempt has been made to set values of the telephone-interference factor which should be used as limits, it being considered important that a large amount of data and experience be obtained before values are set.

The telephone-interference factor is the ratio of the square root of the sum of the squares of the weighted values of all the sine-wave components (including in alternating waves both fundamental and harmonics) to



CURVE SHOWING WHAT FREQUENCIES INTERFERE IN TELEPHONE CIRCUITS MOST SERIOUSLY

the root-mean-square value of the wave. Frequencies near 1100 cycles are regarded as most obnoxious.

Telephone-interference factor may be readily found by means of a portable instrument when connected through a definitely specified network to the voltage wave under investigation. This instrument is described as "a sensitive vacuum thermocouple provided with a shunt and a direct-current milliammeter."

An extensive table giving the telephone-interference factor for machines of well-known design was included in the report.

Great interest was shown in the paper, and in the ensuing discussion. W. J. Foster pointed out that many machines having excellent wave forms, as indicated by oscillograms, were listed as having high telephone interference factor. J. B. Taylor said the report dealt apparently with alternator wave forms without taking account of the influence of the line under load. Dr. Steinmetz stated that the report should deal with other difficulties than those in the telephone circuit, and he did not think that power engineers were ready for a standard wave form. Attention was directed by Dr. A. E. Kennelly to the fact that the curve for weighing frequencies amounted to a resonance curve for the telephone diaphragm. Professor Adams stated that the report was only intended to cover the telephone-interference problem, leaving other difficulties for the future committees. The report was also discussed by L. W. Chubb, Dr. J. B. Whitehead, J. J. Linebough, Dr. E. E. F. Creighton, and L. T. Robinson.

MUCH PROGRESS ACHIEVED IN RADIO-TELEPHONY DEVELOPMENT

Great Future Is Predicted for Wireless Telephony—Historical Development During the War Period and Apparatus Devised Are Described

In discussing "Radio-Telephony," with particular reference to development during the war period, E. B. Craft and E. H. Colpitts called attention to the usefulness of this form of intercourse. The possibility of oral communication between any two persons in the civilized world at any time is, of course, the ultimate object for which engineers are striving. Mr. Craft summed up the possible use of wireless telephony as follows:

"It is easy to see that radio-telephony can never compete with wire telephony in densely populated districts, while wire telephony is a physical impossibility at sea and in the air. Fortunately, however, the connection of a wire system to a radio system is no more complicated than connecting two wire lines by means of a repeater, and therefore these two fields, although distinct, are adjacent. The establishment of communication between two given individuals will be most efficiently realized through the use of a combination of wire transmission on a network extending over perhaps 99 per cent of the stations and radio transmission to those relatively few stations to which it is either impossible or impracticable to build lines."

The authors of the paper traced the whole historical development of the theory of radio-telephony and then described the communication sets especially designed and built for war purposes. Before the armistice was signed production had reached the necessary quantity basis, according to the authors. The major part taken by the engineering staffs of the Western Electric Company and the American Telephone & Telegraph Company was explained.

Donald McNicol presided at the Friday morning session devoted to telephony. When he called for the discussion of the paper by Messrs. Craft and Colpitts, Major-General Squier paid high tribute to the engineers of the Bell system for their coöperation with the Signal Corps. He also called attention to the fact that the government now invites the efforts of any engineer who can improve the efficiency of the ocean cable systems, which are badly overloaded. Owing to the great capacity of these cables, it is necessary to devote nine hours out of every twenty-four to running off the charges accumulated each time the key is closed. He said the government would finance promising experiments and permit the use of the Alaskan cable for tests. Dr. M. I. Pupin said that the development of the audion by Dr. Lee De Forest was one of the most important inventions of the last twenty years.

"Telephone Circuits with Zero Mutual Induction," by William W. Crawford, was read only by title.

INSULATION AND ITS IMPROVEMENT

The last session of the convention, which was devoted to discussions of factors affecting the design and performance of insulations, was opened by President Adams, who said that the fact that higher voltages are not being used with generators and cables is chiefly due to the inability to approach the ideal of homogeneous insulation. The papers mark an epoch, he said, in the study of insulations and indicate paths along which manufacturers can develop insulation.

IONIZATION OF OCCLUDED GAS IN INSULATIONS

Weak Point in High-Tension Insulation—Method of Measuring Stress at Which It Starts—Need of Reducing Gas Spaces

Assuming that the solid part of insulation for high-tension equipment is in perfect condition and has a low enough dielectric loss to insure against cumulative heating that may cause excessive temperature rise, occluded gases are the weakest points in insulation, according to G. B. Shanklin and J. J. Matson. This is true because, above a certain thickness, air is dielectrically weaker than commonly used insulations and because the corona which occurs when it is overstressed will deteriorate the solid insulation. Therefore special attention must be given to preventing air pockets or films or at least to minimizing their thickness. Since the stresses exerted on these pockets are greater the higher the permittivity of the solid dielectric is, materials of the lowest permittivity should be used. Roughly the life of insulation in which izonization occurs is from six months to six years, showing that the damage is gradual but still deserving of serious consideration.

With these limitations to satisfactory use of insulations in mind, Messrs. Shanklin and Matson have measured the dielectric losses of various insulated coils and cables for gradually increasing voltages to determine the point at which ionization starts.

According to the tests made, it was concluded that 19 kv. or 20 kv. per centimeter should be the maximum allowable working stress that should be allowed in ordinary lead-sheathed, single-conductor paper cables filled with mineral hydro-carbon base compound. In well-constructed varnished-cambric-covered cables with half-lap turns, the maximum thickness of air space found next to the conductor was 0.008 cm. at 25 deg. C. and 0.003 cm. at 100 deg. C. This was about the order of thickness found in paper cables with mineral hydrocarbon compound. The maximum values of voltage gradient were lower, however, because of the higher permittivity of the cambric. For black-varnished cambric taped cables, carefully brushed in the making, the gas spaces were 0.011 cm. and 0.0035 cm. at 25 deg. C. and 100 deg. C. respectively.

The dielectric loss caused by ionization in baked flexible mica-wrapped cable was much greater than in fresh samples, and aging enlarged the gas spaces. For fresh samples the thicknesses of the gas spaces next to the conductors were of the order of 0.0075 cm. at 25 deg. C. and 0.0025 cm. at 100 deg. C. For aged samples the corresponding thicknesses were about 0.023 cm. and 0.012 cm. respectively.

VOLTAGE GRADIENT IN ENTRAPPED AIR

As might be expected, the dielectric strengths of air films between solid insulating material are practically the same as between conductors, according to tests conducted by F. Dubsky. He has also shown that the voltage gradient in entrapped air where a uniform field exists is equal to the product of the resultant permittivity and impressed voltage divided by the total insulation thickness.

In cable insulation the electric field is radial so the stress in entrapped air will be expressed by the formula $(KE/r_x)\ (1 \div \log_e^{\bullet} R/r)$, where K is the resultant permittivity of the insulation, E the impressed voltage, r_x the distance from the center of the cable to the film considered, r the radius of the conductor, and R the outside radius of the insulation.

Where the air pockets distort the electric field, the foregoing relations do not apply and the field may introduce lateral stresses at the surface of division of the air and taping. According to the gradients which will be ordinarily obtained in air pockets, those not exceeding 5 mils thick will give little trouble in insulations designed for voltages of 12 kv. and less.

PREVENTIVES TRIED AND OBSTACLES ENCOUNTERED

Of all the subjects considered at the convention probably none aroused so much discussion as the study of ionization in air films entrapped in solid insulations. Among the principal phases discussed were the following: Mechanical conditions that give rise to corona; preventives tried and obstacles encountered; reasons for deterioration of insulation by corona; method of outlining investigations when certain information is desired and the method of presenting reports, and the need of coöperative research.

H. G. Reist pointed out that the greatest trouble with internal ionization has been experienced in England, where conductors are insulated with tubes that may not fit tightly. In this country the greatest difficulty is in connection with the insulation of flat rectangular conductors, especially when mica is used, because the insulation tends to bulge away from the flat sides, leaving air pockets. Any fillers that melt may leave voids by running to other parts. Where coils are embedded in slots the sides will help mechanically to prevent bulging if the coils are tightly fitted. As an alternative insulations which are not easily attacked by corona may be used.

Other methods used to avoid ionization were mentioned by L. W. Chubb, among them being the use of dielectrics of low specific-capacity and winding machines that produce enough tension in the wrapping to minimize bulging. He pointed out that it is difficult to obtain a material which has both low specific capacity and heat resistivity, so the problem is attacked mechanically in most cases. The formation of nitric acid inside the air pockets was suggested as the cause of insulation deterioration when ionization occurs. There-

fore, if the insulation is not allowed to "breathe" air the destruction should not be great. Insulations outside of slots have not the mechanical support to prevent bulging, but the potential gradient is less there.

Dr. J. B. Whitehead criticised the preceding investigations because, in his opinion, air films do not usually occur in large areas or with uniform thickness. He urged tackling problems from a less speculative point of view and presenting reports of investigations with more exactness so the accuracy of results can be better judged.

While it is difficult to determine in advance all conditions which will be brought about by usage of insulation, W. J. Foster suggested that valuable information might be obtained by subjecting insulated conductors to distortions which are likely to happen in assembling or during operation and then conducting tests on the ionization of the insulations. In so doing consideration must be given to the effects of temperature change.

In H. W. Fisher's opinion it is practically impossible for air films to be as thick as 3 mils in well-made cables. He suggested that it might be interesting to determine the cause of rise in dielectric strength after the resistivity reaches a certain point. Thin compound might fill cable insulations satisfactorily, but stretching of the lead sheath may allow air spaces into which compound will run if the cable slants, Mr. Fisher contended. It might be better to have a compound with slightly higher dielectric losses if higher flexibility and less fluidity can be obtained.

From observations, R. R. Argersinger said that mica insulations show more evidence of corona than combination insulations, but the damage is not so great.

To throw some light on the reason why corona disintegrates solid insulation, Prof. C. F. Harding said that nitric-acid yield is dependent on certain critical amounts of air supplied, pressure, temperature, etc. He had also observed that combinations of ozone and nitrous oxides attack materials more severely than nitric acid alone.

L. W. Chubb expressed the belief that the corrosive effect of corona is due more to the nascent nitrous oxides formed than it is to presence of ozone. While pitting of mica does not go far, it does penetrate several layers, he said.

F. W. Peek, Jr., pointed out that the effect of dielectric capacity on charging current also has to be taken into account in selecting dielectrics for insulations.

Pitting from corona seems to be due more to mechanical bombardment than to other causes mentioned, said Professor Adams, because it powders the solid dielectric and because not enough air is usually present in pockets to produce sufficient nitric acid to cause damage. The frequency of corona discharge is many times line frequency when an air film breaks down, thereby increasing the energy losses. Another interesting phenomenon was mentioned by Professor Adams—that of the displacement current in dielectric being forced at right angles to its direction by the magnetic flux, present around all conductors, causing concentration of flux. High vacuum inside the pockets would also augment corona.

ABNORMAL VOLTAGES WITHIN TRANSFORMERS

Prevention of Breakdown of Transformers Possible by Studying Distribution of Voltage Along Windings, Eliminating Excessive Concentration

By showing in what way transformer constants influence voltage concentration along the windings, L. F. Blume and A. Boyajian indicated how a transformer may be designed so as to mitigate the stresses occasioned by a given voltage disturbance. This method of avoiding breakdown is more economical than the one which uses external protective devices, in the authors' opinion. Some of the conclusions drawn are that transformers differ from transmission lines as regards distribution of voltage, capacitance, etc., chiefly on account of the presence of coil to coil capacitance and mutual inductance. Three kinds of disturbances are recognized—abrupt impulses, rectangular wave fronts which have long tails, and sustained high-frequency voltages.

In considering abrupt impulses the authors show that the presence of coil capacitance causes the transformer to respond as a pure capacitance and not as an inductance to abrupt impulses and toward all frequencies above its lower natural frequencies of oscillations. The voltage distribution within the transformer windings for abrupt impulses and for high frequency depends upon a factor alpha which is equal to the square root of the total capacitance of the winding to ground divided by the total coil capacitance from one end of the coil to the other. The greater the value of alpha the greater the concentration of voltage at the line ends and the smaller the voltage in the interior of the winding. The maximum volts per unit length of coil stack at the line end are equal to alpha times the value of the voltage corresponding to uniform distribution.

If the impulse is of the rectangular wave form with long sustained tail, the phenomenon within the transformer will be the same as before, but it will now be followed by a series of damped oscillations, the amplitudes of these oscillations depending not only on the amplitude of the impressed wave but also on the value of alpha and on whether the neutral is isolated or grounded. In addition to being proportional to the value of the impressed wave the amplitude of oscillation for a given harmonic is smaller the higher the harmonic and the smaller the value of alpha.

When the applied frequency is greater than the natural frequency of the transformer, the reaction of transformer is similar to its reaction toward abrupt impulses. High internal voltages are built up only at the lower frequencies.

Among the engineers who discussed Mr. Blume's paper were Dr. E. E. F. Creighton, H. R. Summerhayes, G. Faccioli, Prof. C. A. Adams, F. Dubsky and F. W. Peek, Jr.

Professor Adams said that it is to the men who develop laws and foundations which serve as a basis for future design that great appreciation is due. Since it is difficult for the most highly trained mind, however, to state mathematically and accurately conditions that may exist, the only check on mathematical analyses is actual test.

Starting Synchronous Motors

How to Avoid Excessive Currents and Mechanical Strains in Synchronous Motors Started as Induction Machines—Switching May Be Guided by Field Ammeter or Accomplished by Properly Arranged Relays

BY E. E. GEORGE
Electrical Engineer, Chicago, Ill.

GETTING a synchronous motor into step with the line, under its own power, is comparable to shifting two high-speed gears into mesh with more or less load on the driven gear. Within certain narrow limits of difference of velocity the shock is less than full-load stress and is allowable. Above these limits the operation of starting appreciably shortens the life of the machine and may even wreck it. But directions for starting any polyphase synchronous motor as an induction motor can be made very simple if the starting characteristics are once observed and analyzed by the electrical engineer in charge. Starting under normal conditions can then be left to inexperienced operators. The use of relays for automatically changing from starting to normal voltage is highly recommended. In case of manual operation, however, a field ammeter can be arranged to show when the motor has reached synchronous speed.

During starting the field windings may be: (a) Sectionalized by a break-up switch provided by the manufacturer; (b) short-circuited by a double-throw field switch; (c) open-circuited; (d) shunted through an intermittent duty discharge resistance by leaving the field switch in an intermediate position; (e) shunted through a continuous-duty discharge resistance at all times, but with the field switch open during starting; (f) closed on an independent source of direct current; (g) closed on the armature of a generator or exciter driven by the motor itself, so that the exciting current is zero to start.

Analysis of Starting Torque

Certain phenomena of starting should be considered before deciding on the best procedure. For convenience in description a three-phase motor with a rotating field will be considered. It will make no quantitative difference whether spool-wound or slot-wound fields are assumed, although spool-wound (or salient-pole) fields ordinarily have the best starting characteristics.

The starting torque of a synchronous motor is due to any or all of three sets of induced currents in the field structure: (a) in the iron of the poles; (b) in the copper or brass squirrel cage, if any (modern self-starting motors have a carefully designed squirrel cage which helps also to prevent hunting, surging and phase unbalancing); (c) in the field windings if the circuit is closed.

Owing to its uniform distribution around the air-gap periphery the second circuit (b) has a torque equal to a constant times $SR/(R^2 + X^2)$, where R is the resistance and X is the reactance at any slip S for the squirrel cage.

The first circuit, if the machine has coil-wound poles, and the third circuit in any case, are not uniformly distributed, and the torque pulsates, owing to the pulsating nature of interaction between the primary field and the secondary current-carrying circuits. The three phases of the primary produce a steady field, unidirectional and revolving synchronously with respect to the primary or stator windings. The secondary field winding on the rotor cannot exert a constant unidirectional or a revolving reaction on the primary field, as a squirrel-cage winding would. The iron, however, acts like the field winding, in the case of a coil-wound field, while in a slot-wound field it acts like a squirrel cage.

The torque due to the field winding does not vary as a continuous function of $RS/(R^2 + X^2)$, but becomes zero or negative at certain fractions of synchronous speed. It is practically zero between half and three-quarters of synchronous speed. Such a winding alone is of little help in starting a motor as it will not accelerate it beyond half speed. The reaction of the single-phase secondary field also tends to cause an unbalance of the primary currents.

Although the effectiveness of the reaction in the secondary depends upon the distribution of the iron and copper of the secondary, the power losses involved in the internal reactions and the negative torque due to their odd harmonic components will, in general, utilize all the available energy, and the machine cannot accelerate. Accordingly the field winding is a hindrance to starting to some degree, and in certain motors has to be kept open or closed through a high resistance.

Before the motor reaches synchronous speed it acts like a transformer and induces a high voltage in the fields, particularly if they consist of many turns, as for 220-volt and higher sources of excitation. This high voltage may break down the insulation or endanger the operator should he touch the slip rings or field switches. If the external resistance across the field terminals can be made reasonably small without interfering with starting, the voltage drop across it at low speed may be low enough to be comparatively safe.

Field Circuit Closed Through Exciter

The armature of a direct-current generator offers moderately high inductance and very low resistance to the alternating induced field currents, regardless of whether the generator is developing direct current or not (disregarding the tendency of the superimposed direct current to cause odd harmonics in the alternating-current circuit). And if the field can be left permanently connected across the armature of the generator which furnishes the excitation, the field circuit is thus closed during starting.

If the exciting generator is driven by the synchronous motor, the direct-current voltage will be zero to start, and by adjusting the motor and exciter-field rheostats

so that the motor reaches about three-quarters speed before the excitation builds up to about half of that normal for no load, the field can be left permanently connected to the exciter armature. If the voltage does not build up to about one-third normal, it will not pull the rotor into synchronism with the proper polarity.

It is assumed that the field will be excited while the machine is still on reduced voltage, as this is preferable for ordinary conditions. In changing from the low-voltage taps of the compensator to full line or running voltage, the time interval should be as near zero as posible (not more than 5 cycles) because if the rotor drops back one pole the counter emf. of the motor and the line voltage are cumulative in direction, and the action is practically that of a polyphase short circuit at double voltage on the line. This is the usual cause of tripping the overload devices during starting. The shock to the machine and to the system is severe, even with current-limiting reactance on the line, and should be avoided. The same shock is produced by changing over to line voltage with the rotor in synchronism but of wrong polarity, owing to the field excitation not being sufficiently heavy to pull the rotor into proper polarity at reduced voltage.

If the voltage change-over can be made quickly enough, there is no danger in raising the excitation to normal value for full load, after the machine has passed about three-quarters speed and before the change-over is made. If self-excited, the motor and exciter rheostats can be adjusted before starting so as to time the field current just right for the acceleration, and with a larger margin of certainty in each direction than can be attained by the best manual adjustment after starting.

Hand-operated oil circuit breakers are quick enough if properly mounted and operated, but solenoid breakers electrically interlocked will make the change-over with an interruption of not over two or three cycles. If, before changing to running voltage, the excitation is high enough to produce unity power factor on running voltage, there will be little surge of current in changing over, as then the counter-emf. and the line voltage are nearly equal and opposed (provided that the rotor does not slip back). If the rotor does slip back, it may be necessary to weaken the field circuit before changing to running voltage and to defer increasing it until the increased voltage has pulled the rotor into synchronism again, which will happen unless the load is excessive.

FIELD AMMETER INDICATES SYNCHRONISM

In this connection it is desirable to mention a highly valuable method of discovering when synchronous speed is reached in a synchronous motor or synchronous converter. Simply watch the needle of the field ammeter, which must be of the D'Arsonval or permanent-magnet type. It is necessary to have the meter in a closed circuit with the field winding, and if conditions prevent closing it through an intermittent duty discharge resistance or through the armature of the exciting generator, a continuous-duty non-inductive resistance should be placed across the field terminals. This resistance should be low enough to prevent dangerous voltage across it in starting, and also low enough to give a fair ammeter deflection when the rotor pulls into synchronism without excitatio

The field ammeter needle will remain still until the machine reaches about three-quarters speed (on a 60-cycle machine), when it will begin to tremble, with the vibrations getting slower and wider as the machine speeds up. Just as the rotor locks into step, regardless of polarity, the needle will make a violent wide swing backward and then come to zero and stay there without much surging (if the exciter circuit is open). If direct current is flowing in the field, the needle will act much the same, except that it will come to a positive steady reading instead of to zero. Before reaching synchronism the direct current does not affect the needle much, because in most machines the induced alternating current is greater than the direct current. Every synchronous motor should be provided with a field ammeter and the operator should become accustomed to watching its behavior during starting.

AUTOMATIC SWITCHING

If a normally open circuit-closing instantaneous low-voltage alternating-current relay is connected in series with a 2-mfd. or larger condenser across the field terminals, it will operate when the machine reaches synchronism (owing to the disappearance of the alternating-current voltage), and with its contact circuit in series with the contact circuit of a normally open circuit-closing instantaneous overload direct-current relay in series with the excitation circuit, will properly control the change-over to running primary voltage, and starting can be made entirely automatic. This system of only two relays is simpler and safer than that used for automatic substations at present and is independent of definite time-limit relays. The direct-current overload relay should be set so that it will not operate until the excitation is high enough to pull into step the maximum load to be started at the minimum primary running voltage.

Because of the large number of factors affecting the result it would not be practicable to outline in detail here a complete system of tests that would automatically determine for every case the best starting procedure. Among these factors are the maximum instantaneous primary current allowed by the rules or by the cut-outs of the supply company, the number of taps on the compensator, the maximum load to be started, the exciter voltage, the insulation of the field coils, the time allowed for starting (in the case of fire pumps), the amount of interlocking with other circuits, the mechanical strength of the driven equipment, whether the motor is self-excited or independently excited, whether the starting is manual or automatic, etc.

When possible the following method is desirable: Use a self-excited motor, connect the field permanently across the generator armature, adjust the field rheostats as previously described, and set the compensator leads on the lowest taps that will start the motor and pull it into synchronism. To start: Close the starting primary switch, and after the field ammeter shows that the machine has reached synchronism and that the exciter has built up to normal voltage, quickly open the starting primary switch and close the running one. To shut down: Open the latter switch. With this method there are no dangerous field voltages, no complicated starting rules, no rheostats to adjust, and no overload shock to the machine or to the system.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

REMEDYING TROUBLE MET WITH ROTOR OSCILLATOR

Failure of Device Used to Oscillate Shaft of Rotary Cured by Spring Holding Ball in Proper Position

BY GEORGE A. ILER
Superintendent of Operation Georgia Railway & Power Company

At one plant where a rotary had settled out of level trouble was experienced because the oscillating device, which was of the ball-bearing and thrust-plate type, failed to function. At heavy loads the field would pull the armature over against the ball so that the armature would oscillate for a while but not continuously. It was out of the question to relevel the machine, because the foundation had been embedded in concrete to a depth of 12 in. (30 cm.). One of the maintenance men discovered that if he held the ball of the oscillator at the bottom and normal rest position in its race, the armature would oscillate all right, so a small spring-brass pointer about 6 in. (15 cm.) long and very flexible was put alongside the ball to keep it from rocking back and forth in its race. This spring held the ball in its normal position all the time when not under pressure, causing the armature to oscillate normally.

EMERGENCY METHODS FOR USE IN INDUSTRIAL PLANTS

Methods of Quickly Providing Feeders and Motor Drives, Avoiding Long Interruptions of Service—The Plan May Be Applied Elsewhere

BY H. S. RICH

Some expedients were adopted during the rush of war work which may be advantageously applied in emergency cases that arise now provided they are not retained permanently to the exclusion of better methods. For instance, in one New York State plant where production had to be got under way immediately in a new extension delay was avoided by running open-wire feeders until conduit could be installed. Four-wire power lines were stretched the whole length of each floor by dead-ending them at each end with strain insulators and attaching them to the intermediate beams with single-wire cleats. In this way circuits were installed within a few days, whereas it took several weeks to complete the conduit system. Temporary or emergency connections were made to these feeders as required.

While waiting to install the motors and control in a permanent manner temporary drives were provided by securing the motors to any convenient foundation with lag screws and boxing in the belts with guards made of slats. Where motors for the permanent installation had not been received, large motors on hand were temporarily installed and shafting hung overnight to drive groups of machinery. The starters were set in convenient places temporarily. Later the equipment was installed in more approved fashion by bolting the starters to columns and providing for overhead mounting of the motors on the stringers. Measurements were taken to determine the spacing of bolts and the motors hoisted into place and attached during noon hour. Everything was planned carefully in advance so there would be no delay in making the changes.

In the forge shop, where new oil furnaces were installed and the blast-fan motor which had been used was inadequate for the service, an additional motor was delivered on skids, which were set on the dirt floor and braced and bolted to nearby objects. The starter was screwed to the skids and wires connected with the open-wire feeders previously mentioned. Within three weeks this gave way to a permanent installation.

As the shop was working under extra pressure it was never known when a breakdown would occur, so extra motors rated at 5, 7½, 10, 15 and 25 hp. were ordered for emergency installations. The 15-hp. motor was hardly received when power for five large grindstones was interrupted, suspending work on thousands of steel sections. The motor was immediately installed on the concrete floor, braced from the ceiling by 4-in. by 6-in. (10-cm. by 15-cm.) spruce timbers and blocked against a brick pier in such a way that it could not move. A split pulley was put on a section of the shaft driving the grindstones and connected with the newly installed motor, so that the grindstones were running again after only a few hours' interruption. Repairs were then made on the permanent drive.

Other cases like this were handled in a similar manner, while overloaded motors were assisted by installing additional motors. Where groups of machines were driven by an overloaded motor the machines were separated mechanically and driven by separate motors. Electric fans were employed to improve the ventilation of other overloaded machines that could not be shut down.

In one case, where some gears began to run hot and operations could not be interrupted, they were dosed with caster oil and powdered graphite. This treatment was costly and did not remove the cause, but it prevented shutdown. Once a starting box was completely ruined by a short circuit in the resistance coils, so a barrel of water and two iron plates were used as a water rheostat for starting.

One of the greatest advantages in making emergency installations and repairs is to have motors of one make throughout a plant, thus allowing interchangeability of pulleys, rotors, end shields, bearing linings and

starters. Shortly after the busy times began extra pairs of bearing linings were put in stock for each motor. These cost considerable but saved money in avoiding long interruptions of service. Another necessary item was that of keeping all required sizes of fuses on hand (especially the large ones) labeled, tested and assorted. It was found to be poor practice to use wrong-size fuses because nobody ever found time to replace them.

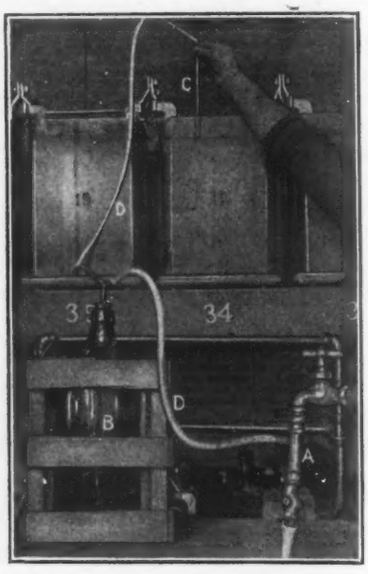
REMOVAL OF SEDIMENT FROM STORAGE CELLS

Where Cells Cannot Be Dismantled for Cleaning, Deposits in Bottom Can Be Removed by Vacuum Without Seriously Lowering Electrolyte

BY M. W. PULLEN AND F. F. SKRIVAN

After four years of rather severe service the cells of the storage battery of the Johns Hopkins University reached a point where a good cleaning out was necessary. Active material had fallen from the plates until it was within a fraction of an inch of the plate bottoms.

There are 130 cells, each of 400 amp.-hr, rating, in the set. The jars are of glass and measure approximately 12 in. (18 cm.) square and 16 in. (24 cm.) high. How to remove the old active material in the bottoms of the cells was a problem. To dismantle the cells, take them down and wash out the sediment was out of the question. Aside from the risk of breaking the jars, expense of new separators and cost, the battery could not be spared for the time required to do the work.



REMOVING DEPOSITED ACTIVE MATTER FROM BOTTOMS OF CELLS

An attempt was made to draw the material up by using a rubber pump with a long suction pipe. This worked, but it was slow and the pump finally broke. The method which was eventually used is best described in connection with the photograph showing the work of cleaning going on. The apparatus consisted of a filter pump *A*, a 5-gal. (19-l.) bottle *B*, a Z-shaped glass tube *C*, and some rubber tubing *D*. Almost any method of producing a vacuum in the bottle besides the filter pump might have been used. The latter was handy and easy to run. The bottle was provided with a cork having two glass tubes through it. To one the filter pump was connected and to the other the glass Z-tube, rubber tubes being used for the connections.

Water was turned on at the filter pump, causing a partial vacuum in the bottle. By inserting the glass Z-tube in the battery jar the sediment was drawn up. As the process went on the end of the glass tube was moved about over the bottom of the jar and the loose material thus removed. To be sure, the acid level in the jar was lowered during the cleaning process, but as the cells were not in service at the hours worked upon this made little difference. They were refilled with electrolyte before heating could take place. The mixture of electrolyte and old active material in the bottle was emptied into a spare battery jar and allowed to settle. The clear electrolyte was siphoned off and used in filling the jars.

The time required per cell was approximately half an hour. Six or eight cells were cleaned per day according to the time available from more pressing duties.

COMMON SENSE DOUBLES EFFICIENCY OF PLANT

Attention to the Ordinary Things Which Every Engineer Should Know How to Care For Saves 50 per Cent in Coal Consumption

In one plant attention to operating data brought the plant efficiency up from 32 per cent to 68 per cent, said Edward Marshall of Cincinnati, speaking before the station operating committee of the Ohio Electric Light Association. Very little attention had been paid to efficiency until instruments and stack thermometers were installed, but things became very different afterward. Readings showed stack temperatures of 800 deg. to 900 deg. Fahr. (427 deg. to 482 deg. C.). Draft readings over the fire showed 0.8 in. (20 mm.). The Venturi tube and a crude coal scale showed that 3.3 lb. of water was being evaporated per pound of coal burned. The feed-water temperature was only 130 deg. Fahr. (54 deg. C.) when enough steam was blowing through the roof to heat it to 210 deg. Fahr. (99 deg. C.).

One boiler at a time was gone over. It was found that the bottom and rear baffle was practically gone in each case. There was a large accumulation of soot on the tubes at both the front and rear headers. The tubes above the first three rows had not been bored for a period of three years. The boilers were rebaffled by using Y tile in the bottom row, taking out the vertical baffles and putting a baffle on top of the eighth and fourteenth rows, making a three-pass boiler. The Bayer soot blowers were repaired. The tubes were cleaned inside and out. The stokers were retopped and provided with new dump grates.

Then it was found that a draft of 0.35 in. (9 mm.) could be obtained over the fire, and that the stack gases were reduced to a temperature of about 600 deg. Fahr. (315 deg. C.). The amount of refuse in the ash was reduced from 40 per cent to 15 per cent. While the net result was that the efficiency of the plant was increased from 32 per cent to 69 per cent, the fuel saving was 50 per cent. Common sense made the difference.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

FIGURES AS TO METER READER'S MOVEMENTS

Analysis Shows Number of Meters Read, Time Taken, Stairs Climbed, Blocks Walked, Streets Crossed, Poles Climbed, Etc.

Some interesting figures on the movements of a meter reader are furnished by J. A. Gibson of Dunkirk, N. Y., in the accompanying table. Attention is called to the number of fuse boxes found open. All boxes were closed the previous month. Most of the open boxes were found in factories.

Days Engaged	Hour Engaged	Meters Read	Stairs Climbed	Veranda Stairs Climbed	Doors Opened	Blocks Walked	Number Streets Crossed	Poles Climbed	Revealed Every Month	Installed on Porches	Meters Read per Hour	Fuse Boxes Found Open
1	4	171	59	36	369	40	25	1	0	0	42¾	2
	4	168	84	61	452	57	59	0	0	1	42	2
1	4	131	78	69	429	59	60	0	0	2	32¾	1
	4	121	69	46	374	51	63	1	0	1	30¼	0
1	4	124	52	46	381	41	79	1	0	1	31	1
	4	115	67	55	428	54	71	0	0	2	28¾	2
1	4	116	79	69	407	60	64	0	0	0	29	0
	4	102	76	62	388	54	62	2	0	0	25½	0
1	4	126	74	62	401	54	61	0	0	3	31½	0
	4	102	96	81	372	41	58	0	0	0	25½	1
1¼	4	109	84	76	391	47	50	4	0	6	27¼	0
1	4	59	21	4	138	...	0	0	35	0	14¾	9
	4	49	19	2	101	...	0	0	33	0	12¼	5
1	4	46	22	6	112	...	0	0	28	0	11½	8
	4	13	4	1	45	...	0	1	3	0	3¼	1
7½	60	1552	884	676	4778	558	652	10	99	16	25⅞	32

CONTRACTORS INVITED TO FORMULATE SALES PLANS

Providence Lighting Company Makes Bid for Co-operation and Good Will—Letters Inviting Closer Relations Sent Out

Good will among the electrical contractors has been recognized by lighting companies as an asset. A number of companies are actively trying to increase this good will. It is doubtful, however, if many utilities have gone so far as inviting the contractors to help the company formulate sales plans. As will be seen from the following letter, this plan is being followed, at least in this instance where the contractor is especially affected, by the Narragansett Electric Lighting Company, Providence, R. I.:

NARRAGANSETT ELECTRIC LIGHTING COMPANY
EXECUTIVE OFFICES
PROVIDENCE, R. I., Feb. 4, 1919.

To Electrical Contractors:

We take great pleasure in notifying you that the customer has been relieved of financing extensions, also service connections. Those requiring consideration by the company will be handled as prior to last August by guarantees on the part of the customer.

We are one of the first of the central stations to go back to a pre-war basis in the matter of financing extensions and connections, thereby releasing a large volume of business for you which has been held up because of these restrictions. It is our intention to coöperate with you to the fullest extent at all times, and we welcome suggestions from you from time to time that will improve our mutual interests.

We have under consideration a house-wiring plan that we hope may be adopted at an early date. In the meantime will you be good enough to tell us either in writing or in person your ideas as to how it can be best handled?

Trusting that you will avail yourself of the opportunity existing to secure a large amount of business, we beg to remain. Very truly yours,

E. R. DAVENPORT,
Sales Manager.

UTILITIES MUST ENCOURAGE SALES OF SOCKET DEVICES

Canadian New-Business Manager Points Out the Interest That the Lighting Company Has in the Development of the Appliance Market

That central stations should make every effort to encourage the sale of energy-consuming devices was emphasized by W. B. Johnson, manager of the new-business department of the Montreal Light, Heat & Power Company, Cons., before the January meeting of the Association of Municipal Electrical Engineers of Ontario. He stated that he firmly believed that should electric companies discontinue the development and sale of appliances not only would the sale of such appliances greatly decrease but that gradually the use of such appliances as are now in general use would be discontinued. This, he said, was not any reflection on the selling ability of contractors or other merchants but due to the fact that these other merchants did not have the interest in sales that a central station has. The public expects the electric company, he stated, not only to handle all the latest appliances but to handle the best at a fair price. "Should they discontinue the sale of appliances the market would be flooded by unreliable merchants with cheap, worthless and very unsatisfactory goods. This, you know, would hurt our business, the selling of electric energy, more than one would think and would also kill the sales of reliable dealers."

The pushing of appliance sales, Mr. Johnson held, should mean increased sales for all dealers. Every appliance sold, provided that it gives satisfactory service, helps sell other appliances. However, these appliances should not be sold, he felt, at a loss. To sell at a loss prevents other dealers, particularly contractors, from making a profit. He said that if utilities cut prices it meant that every merchant must discontinue selling appliances and that the utility would therefore sell more, which does not necessarily mean that there would be any more in service than the lighting company's lines. By maintaining prices the utility has that many more salesmen working for the company without being on its payroll. Mr. Johnson was not quite of the opinion

that manufacturers' prices were fair retail prices, but thought rather that the resale price should be based on the average cost of contractor-dealers plus their margin of profit, which would, no doubt, be higher than were it based on the cost of the public utility.

He is furthermore of the opinion that every cent of net profit derived from sale of appliances, together with such addition of amounts as records will permit, should be expended in educational, sales and good-will advertising.

PROOF THAT HIGHER LIGHTING INTENSITIES PAY THEIR COST

Data on Increases in Factory Output That May Be Obtained When Good Illumination Is Properly Applied

Central-station salesmen have long asserted that increased lighting in factories will stimulate industrial production. It is only within the last few years, however, that data on actual tests have been available to prove that lighting does stimulate production, to show what percentage of increased production may be expected and to indicate to what intensities it may be wise to go.

Last week W. A. Durgin of the Commonwealth Edison Company, in the course of an address before the Chicago Section of the Illuminating Engineering Society, gave the detailed results of four completed tests which were more briefly mentioned at the New York convention of the society on Oct. 12, 1918, and reported in the ELECTRICAL WORLD of Dec. 7, 1918.

To the lighting salesman these data are important, especially at this time when the problems of reconstruction are at hand. If good lighting does mean greater output and if this fact can be substantiated by accurate data, then good lighting becomes of vital consequence to every manufacturer. Moreover, the question is of great importance to central-station executives. With the lamp engineers constantly making remarkable improvements in their product, the lighting business can remain attractive only if central stations find that the use of greatly increased quantities of light is economically justified Furthermore, electric companies, in order to advise consumers, must know actual facts. For this reason the Commonwealth Edison Company, as a beginning, has undertaken its series of tests to show the true relation between the amount of light used and the production of hand and machine workmen in various industries. The conditions to be met are: (1) The plant investigated should be able to show actual production accurately for distinct machines during definite periods; (2) the product should be so standardized that large outputs may be obtained with all conditions identical except the amount of light used, and (3) a fair proportion of the work must be done during hours of darkness, or the factory must be so placed that the daylight is negligible. These are the ideal conditions. In no case has the Chicago company been able to realize them completely, but in four instances it has interesting data.

A summary of these data is given with this article. While the figures are practically self-explanatory, it may be pointed out that two general conditions are represented by these tests. The first condition shown in test No. 1 is one in which the value of fair lighting over poor lighting is demonstrated. The second condition, illustrated in tests Nos. 2, 3 and 4, is one in which a further large improvement is made in going from fair lighting to excellent lighting. These latter results naturally raise the question as to the limits to which higher lighting intensities may be carried with commercial success, and it is in this field, where intensities may even exceed ordinary interior daylight values, Mr. Durgin stated, that opportunity for further investigation still exists.

TEST INSTALLATION NO. 1

Iron Pulley Finishing Shop.—40 ft. by 80 ft.; 13-ft. ceiling. Old equipment: Drop cords, 60-watt lamps, bare, in tin shades, 0.27 watt per square foot—0.2-ft.-candle. New equipment: "Reflecto-cap" 200-watt units, 10 ft. mounting height, 1.9 watts per square foot—4.8-ft.-candles.

Results of improved lighting in percentage of increase:

	Office Records	Test Records
Square feet of turning.....	30	35
Square inches of boring.....	34	16
Set screw holes.....	...	6
Cubic inches of key seating.....	100	..
Balancing	...	22

Average from test records, 20 per cent increased production.

Average from all records, 35 per cent increased production.

Cost—Maintenance (twenty hours per month), electricity, depreciation (15 per cent) and interest (6 per cent) = $105 per month = 5.55 per cent of payroll ($1,900 per month).

TEST INSTALLATION NO. 2

Soft-Metal-Bearing Machine Shop.—48 ft. by 50 ft. "Normal" equipment; twenty-five 100-watt vacuum Mazda lamps in deep-bowl reflectors, 1 watt per square foot—4.6-ft.-candles. "Productive" equipment: twenty-five 200-watt gas-filled Mazda lamps in deep-bowl reflectors, 2 watts per square foot—12.7-ft.-candles.

Results of productive intensity in percentage of increase: Flanging, 20; hueing, 24; rolling, 9; setting, 8; bundling, 27; second bore, 13; punching, 10; perforate and blank, 12. Average from shop records, 15 per cent increase.

TEST INSTALLATION NO. 3

Heavy Steel Machine Shop.—40 ft. by 58 ft. "Normal" equipment: Thirteen 100-watt gas-filled Mazda lamps in 23-in. eye-shield units, 0.6 watt per square foot—3-ft.-candles. "Productive" equipment: Thirteen 300-watt gas-filled Mazda lamps in same units, 1.7 watts per square foot—11.7-ft.-candles.

Results of productive intensity in percentage of increase: Drilling, 11; milling, 6; screw-machine work, 14. Average from test records, 10 per cent increase.

Cost of productive intensity: Additional electricity, additional cost of lamps, depreciation (15 per cent) and interest (6 per cent) on new units = $29 per month = 1.2 per cent of payroll.

TEST INSTALLATION NO. 4

Carburetor Assembling Shop.—50 ft. by 80 ft. Old equipment: Eighty-four 40-watt vacuum Mazda lamps in four-light clusters; two 100-watt bare gas-filled lamps; fourteen drop cords with 40-watt lamps and tin shades, 1.0 watt per square foot—2.1-ft.-candles. "Productive" equipment: Nineteen 300-watt gas-filled Mazda lamps in 23-in. eye-shield units; ten 200-watt gas-filled Mazda lamps in 16-in. eye-shield units, 1.9 watt per square foot—12.5-ft.-candles.

Result of productive intensity in percentage of increase: Carburetor A, 10.5; carburetor B, 18.6; carburetor C, 6.5. Average from test records, 12 per cent increase.

Cost maintenance (twenty hours per month), electricity, depreciation (15 per cent) and interest (6 per cent) = $57.90 per month = 0.9 per cent of payroll ($6,500).

TECHNICAL THEORY & PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Mechanical Oscillation of Synchronous Machines.—C. DELLA SALDA.—In a former article (*Abstracts*, 791, 1917) the author has treated the problem of the mechanical oscillations of synchronous machines. Dina having criticised (*Abstracts*, 415, 1918) the article aforesaid and the results obtained, the author in the present article demonstrates the reliability of his calculations and results. As the demonstration deals with many points of detail it does not allow of abstraction.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Elettrotecnica*, Sept. 5, 1918.)

Parallel Connection and Voltage Regulation of Large Rectifiers.—B. B. SCHAFER.—Methods are discussed for the paralleling of large mercury-vapor rectifiers with each other and with other sources of current. By using choking coils, especially with the addition of auxiliary windings, the problem may be solved without affecting appreciably the efficiency and power factor. Various methods of voltage regulation are also described and very satisfactory results are claimed. It is a useful characteristic of mercury rectifiers that one or two sizes will cover a range of outputs and voltages which would involve twenty or thirty types of transformers. Within commercial limits, at any rate, mercury rectifiers are unaffected by frequency. The same spacing of electrodes will serve a range of pressures from 65 volts to 650 volts, and there is little practical advantage in adapting the electrodes to a number of current values. The Glarus Rectifier Company has standardized two sizes of steel-clad rectifier for 250 amp. and 500 amp. respectively and for any rectified voltage between 110 volts and 800 volts. The latest mercury-rectifier installations provide up to 16,000 amp. at 250 volts and 550 amp. at 1100 volts. Parallel operation of several rectifiers offers no special difficulty. Once the vacuum is thoroughly established, the pressure drop in the arc is nearly constant at 16 volts to 10 volts down to the lowest current values. The negative nature of the pressure-current characteristic is much less pronounced than in the ordinary arc, and a small choking coil provides suitable ballast and may also be used for purposes of voltage regulation.—*Science Abstracts, Section B*, Nov. 30, 1918. (Abstracted from *Elekt. Zeits.*, Aug. 15, 1918.)

Lamps and Lighting

Electrical Changes Produced by Light.—H. S. ALLEN.—The author views the subject as one of the widest that can be studied. If all matter is built up of electric charges and light is an electromagnetic disturbance, almost any change may be considered to be connected in some way with electricity and with light. Two methods were used in the photoelectric investigation. Dr. Allen thinks it sufficient to assume photo-electrification of the substances in the rods and cones; that electrification would separate electrons in the nerve cells, and set up nervous impulses to the sensorium, and the changes in the retina would be identical in nature with those in a phosphorescent substance or in the photographic plate. He refers to the production of light by electric stimulus or by sudden pressure on the eye, to the asserted visibility of Röntgen rays to dark-adapted eyes, to the curves of the sensitiveness of the eye to rays of different wave lengths which resemble photo-electric curves for those wave lengths, and to selective absorption and color blindness.—*Engineering*, Jan. 17,

Lighting of a Middle-Class Home.—M. LUCKIESH.—The author takes up each room individually and points out what types of fixtures may be properly chosen to secure desirable illumination and the necessary artistic appearance.—*Electrical Review*, Feb. 1, 1919.

Generation, Transmission and Distribution

Boiler-Feed Water.—NEWTON HARRISON.—The writer discusses the examination of boiler-feed water and the chemical treatment involved in its purification. Quantitative data are given showing the amount of chemicals required.—*Central Station*, February, 1919.

Statistical Analysis of the Central-Station Situation of Canada.—This analysis deals with the steam as well as the hydraulic power plants. Tables of investment and operating expenses are also included.—*Electrical News*, Feb. 1, 1919.

Power Development at Drummondville.—The Southern Canada Power Company is building a concrete dam 1700 ft. (518 m.) long, extending diagonally into St. Francis River at Drummondville, Province of Quebec. It is said that the power house will have a capacity of 18,000 hp. and that the individual units will be 3500 hp. vertical units operating under 32-ft. head.—*Canadian Engineer*, Jan. 30, 1919.

Total of 2,305,310 Hp. Developed from Water in Canada.—The Dominion Census Bureau has just completed a census of the developed water power in Canada, the returns indicating a total of 2,305,310 hp. A table is given showing the geographical and industrial classification of this developed water power.—*Canadian Engineer*, Jan. 30, 1919.

Coal-Handling Appliances at Coventry Electricity Works.—GEORGE FREDERICK ZIMMER.—Special problems involved by the location of the power plant on the canal and because coal is supplied by means of barges are discussed in detail in connection with a number of illustrations. The cost of handling the coal from the barges to the bunkers by means of the conveyors is also given.—*Engineering*, Jan. 10, 1919.

Power Transmission from Bittefeld to Berlin.—Power is transmitted at 110,000 volts over a distance

of 130 km. The line consists of three aluminum cables of 120 sq.mm. section, which are carried on iron poles. Above these is an iron earthing wire of 50 sq.mm. section. The power amounts to 20,000 kw. Three further cables can be carried. The transformers have windings of aluminum. The station in Berlin is very simple and compact, power being distributed at 6000 volts. It is calculated that this scheme dispenses with the necessity of conveying between 300 and 400 tons of coal to Berlin daily.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Elekt. Zeits.,* Aug. 1, 1918.)

Traction

The Gotthard Railway Electrification.—Much information is given concerning the history and the technical and economic features of the Gotthard Railway, with special reference to its electrification. The line, constructed in 1873-97, was taken over by the state in 1909, and the scheme for electrification was accepted about five years later. Prior to dealing with the details of the electrification this article gives full particulars concerning the gradients and general lay-out of the line. With the exception of the Brunnen-Fluelen section, the whole 151 km. from Immensee to Bellinzona is double-track. The first electrification scheme covered the 109-km. section from Erstfeld to Bellinzona, including the Gotthard tunnel; in this short distance the line rises from 475 m. above sea level to the tunnel (which is from 1100 m. to 1150 m. above sea level), and descends again to 244 m. above sea level. The sharpest curve is of 280 m. radius. A commission appointed to consider the matter concluded that electrification would save 20 to 25 per cent compared with steam costs, besides accelerating the service. It was eventually decided to equip the Amsteg and Ritom stations for the direct generation of single-phase alternating current. A summary is presented of the considerations which determined the distance apart of feeding points. Formulas and curves are given for the latter for various traffic densities and line voltages, and a number of tables are presented dealing with estimated costs on various systems of operation, traffic capacity of the electrified line, efficiency, power factor, speeds, tractive performance, regenerative braking, and so forth. It is concluded that regenerative braking offers no great advantage so far as the Gotthard line is concerned.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Elekt. Zeits.,* July 4, July 11, July 18 and July 25, 1918.)

Return of the Trolley Current in a Single-Phase Alternating-Current Network.—J. LHÉRIAUD.—Traction networks with single-phase current produce by induction very serious disturbances upon lines with feeble current running parallel to them. The author shows that the induced emf. in the latter lines becomes less in the degree that the current of traction returns through the rails. He describes experiments made by the Compagnie des Chemins de fer du Midi, both in the laboratory and on the line itself, to determine the resistance, in alternating-current systems, of fishplates, switches, etc., and the proportion of the current returning to the power house through the rails. The results of the experiments are stated, and the employment of transformers at rail joints, as well as frequent grounding of the rails, is advocated.—*Revue Générale de l'Electricité,* Jan. 18, 1919.

Transporting Freight on Electric Railways.—LUCIEN PAHIN.—An examination of what has been accomplished in this direction in America, the British Isles and France. In the Paris district especially the author thinks the practice of American railways could be imitated.—*Revue Générale de l'Electricité,* Jan. 16, 1919.

Industrial Electric Trucks, Tractors and Narrow-Gage Locomotives.—RAYMOND J. MITCHELL.—The conditions under which electric trucks are preferable to manual labor for transporting materials are given, together with a symposium of the several electric trucks now on the market. A typical charging station is shown, illustrating the simplicity and ease with which electric trucks can be recharged and pointing out how inexperienced labor may perform this duty. Advantages of electric trucks, mechanical and electrical features of industrial trucks, transmission, motors and battery equipment, steering gears and safety devices are considered briefly.—London *Electrician,* Jan. 10, 1919.

Installations, Systems and Appliances

Electric Welding.—THOMAS T. HEATON.—The author deals particularly with manufactured steel barrels, drums and tanks. Various methods of welding and cutting involved in this manufacturing work are described, and a table is given showing the time required for welds of various lengths and thicknesses.—London *Electrician,* Jan. 31, 1919.

Electricity in the Docks and Warehouses of the Port of London.—Electricity is largely used in pumping of water and for cranes, conveyors and so on at the docks. The converter substations supplying the power are described and performance curves are given for the electrically driven pumps.—London *Electrician,* Jan. 31, 1919.

New Charts for Aerial Suspension.—JOSEPH N. LECONTE.—Numerical computations involving the catenary curve are rendered troublesome by reason of the transcendental form in which the equation of the curve appears. This makes an exact algebraic solution impossible, and resort must be had to either a more or less approximate algebraic solution or a graphical solution. An attempt is made by the author to solve all cases as far as possible by algebraic equations. When this is impossible reference to tables and curves must be resorted to.—*Journal of Electricity,* Feb. 1, 1919.

Electrochemistry and Batteries

Action of Reducing Gases on Solid Copper.—N. B. PILLING.—It is well known that copper containing disseminated oxide, after heating in contact with reducing gases, becomes weak and friable. In the case of hydrogen the first mechanical effects of the deterioration appear between 400 deg. and 500 deg. C., and at temperatures above 700 deg. the action is very rapid. Deoxidation alone cannot account for this deterioration, and it is pointed out that if steam formed by the reaction is less soluble in solid copper than hydrogen is, then it will be left within the voids formed at some considerable pressure. The combination of this pressure with the intercrystalline weakness of copper at high temperatures would force the individual grains apart.

Microscopic examination of copper after this treatment disclosed intercrystalline fractures.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Proceedings of Franklin Institute,* September, 1918.)

Operation and Chemical Control of Water-Gas Sets in Small Plants.—H. VITTINGHOFF.—This article was written primarily to aid in cases where small gas plants are operated as minor adjuncts in connection with more important electric or street-railway activities. Usually the man in charge of the gas plant who is an electrical operator will know comparatively little of the details of the operations which enter into gas manufacture. Chemical reactions are discussed in such a way as to simplify the power set.—*Stone & Webster Journal,* January, 1919.

Units, Measurements and Instruments

Testing Transformer Oils.—ARNOLD PHILIP.—The important part of a paper on this subject read by the author at the London Section of the Society of Chemical Industry is based on the method of testing for the amount of water in transformer oils. It is known that most minute quantities of water have a serious effect on the insulation resistance of oils and also on the hysteresis of the oils at high frequencies. The quantity of water producing these effects is as low as 0.02 to 0.04 per cent. Methods of testing are outlined in this paper.—London *Electrical Times,* Jan. 16, 1919.

Notes on Steam Meters.—E. CLAASSEN.—Though the mere provision of steam meters has a considerable indirect effect in securing steam economy, the meters hitherto used have conformed imperfectly to the desideratum that they should be both accurate and of rugged construction. Many types of meters yield poor accuracy, while others require skilled attention to keep them in order. One pattern of Claassen steam meter is shown and also the special type of packing employed. Great numbers of St. John steam meters are used in America. A comparison between these two types of steam meters follows.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Zeits. Vereines Deutsch. Ing.,* Aug. 10, 1918.)

Chimney Heat Losses and Their Measurement.—M. CHOPIN.—The author describes a new type of instrument for measuring heat losses in chimney gases, based upon the use of two electric currents, the intensity of one being dependent upon the temperature of the gases and of the other upon the CO_2 contents of the same. The relation between the current intensity and the CO_2 contents of the gases is obtained by measuring the electrical resistance of a solution of caustic soda of known strength and volume with which a definite volume of the chimney gases is agitated. The absorption of CO_2 by the caustic soda and formation of sodium carbonate causes an increase in the electrical resistance and therefore a diminution in the current that can be passed through the solution with a constant emf., for the conductivity of sodium carbonate solutions is only one-third that of caustic soda solutions. The temperature of the gases is obtained by a thermocouple, and the indicators of the results of the two measurements are so arranged that (1) the percentage of CO_2, (2) the temperature of the gases and (3) the loss of heat units can all be read off on one and the same dial. An illustration of the apparatus is given.—*Science Abstracts, Section B,* Nov. 30, 1918. (Abstracted from *Comptes Rendus,* Aug. 26, 1918.)

The Navigational Magnetic Compass Considered as an Instrument of Precision.—M. B. FIELD.—This paper is an abstract of a lecture given before the Institution of Electrical Engineers. The construction of these compasses involved a variety of problems relating to mechanics and mechanical construction, wear and tear of material, the effect of very complex vibrations, fluid friction, viscosity and fluid motions, terrestrial magnetism and the magnetic properties of iron and steel, and complicated systems of magnetic potential and fields of force.—London *Electrician,* Jan. 31, 1919.

Telegraphy, Telephony and Signals

Optimum Secondary Capacity of an Induction Coil.—E. TAYLOR JONES.—In the use of the radio-telegraphic transmitter where an induction coil is used in conjunction with a secondary condenser, the question may arise as to the value of the capacity which connected in parallel with the spark gap yields the longest spark when the primary capacity and the primary current at "break" are given. When the oscillation of both circuits is taken into consideration, it is not obvious that the secondary potential is greatest when the secondary capacity is as small as possible. The problem is considered mathematically in this paper by regarding the oscillations as undamped.—London *Electrician,* Jan. 17, 1919.

Miscellaneous

Electric Heating as a Profitable Load.—BARRY DIBBLE.—This article contains data on the cost and revenue of electric heating on the Minidoka Project, Idaho. It is graphically pointed out that the possibilities are good for combining a heating load in winter with an irrigation demand for the summer months.—*Journal of Electricity,* Feb. 1, 1919.

An Interesting Nile Scheme.—SIR J. WILLOCKS AND JOHN WELLS.—Primarily the scheme to dispose of the waters of the Nile is one of irrigation, but reference is made to the construction of a power station between the Hillet River and Buffalo Cape. Further possibilities in Egypt are opened up by an experiment concerning the utilization of vegetable refuse as fuel. The topographical map visualizes the object aimed at—Reprint of lecture delivered at a meeting of the Sultanieh Geographical Society, Cairo, Nov. 22, 1918.

Some Characteristics of American Coals in By-Product Coking Practice.—F. W. SPERR.—The present tendency in America is to use less of the expensive semi-bituminous coals—Pocahontas, Somerset, etc.—and to use coke mixtures containing much larger percentages of bituminous coals, the volatile matter in such mixtures being from 30 to 35 per cent. The percentage of low-volatile coal runs in usual practice from 15 to 30 per cent. Very fortunately, it happens that not only do such high volatile mixtures produce larger recoveries of by-products, but the coke itself is usually found to give better results in the blast furnace, the decrease in coke consumption per ton of pig iron being in several cases quite marked. H. A. Kuhn estimated that in 1912 75 to 80 per cent of all the iron production of the United States was tributary to the coking coal of the Pittsburgh district.—*Science Abstracts, Section B,* November, 1918. (Abstracted from *Proceedings* of Franklin Institute, August, 1918.)

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities
in the Technical, Commercial and
Manufacturing Fields

COMMONWEALTH EDISON COAL MINES OF GREAT ADVANTAGE

President Insull Estimates Saving from This Source at Not Less than $1,000,000 During 1918— Operations of Company Last Year

In his annual report to stockholders for 1918, Samuel Insull, president Commonwealth Edison Company of Chicago, said that the foresight of the company in providing its own coal mines has continued to be of great advantage. It is estimated, Mr. Insull added, that the saving from this source was not less than $1,000,000 during the year, and in addition the company was at all times reasonably assured of an adequate supply of coal. At one time there were 461,000 tons in storage as a protection against a possible shortage in the general supply.

Among the other matters mentioned by Mr. Insull were the increase in generating capacity, the conservation of capital, and taxes.

During 1918 one 50,000-hp. turbo-generator unit was installed at the Northwest station, making the total generating capacity of the company at the end of the year 1918 730,000 hp. In addition to this installation, two turbo-generator units with a total capacity of 100,000 hp. were in process of installation at the Fisk Street station at the end of the year and were about three-fourths completed. These units will be completed and ready for operation in the early part of the year 1919.

During the year there was a large demand for industrial power, requiring a considerable increase in the company's plant capacity. Whenever line extensions were necessary, however, said Mr. Insull, the customer was called upon to advance the capital therefor, and this accounts for the increase in customers' deposits over the amount shown in last year's report. These advances will be liquidated over the remaining period of the customers' contracts. Aside from such line extensions the company was able to take care of its additions to plant without increasing its permanent securities, while its notes and accounts payable were increased by only a comparatively small amount.

Throughout the year the company made strong effort to conserve capital as well as other commodities, and it issued no stocks or bonds. Mr. Insull announced that since the close of the year, however, the company has sold $4,000,000 of its first mortgage bonds and has paid its notes payable to the amount of $1,500,000.

The situation in regard to taxes was explained by Mr. Insull as follows:

> In conformity with the statement made in last year's report the excess profits tax paid in 1918 on the company's business for 1917, amounting to $133,796, was charged against surplus as shown in the accompanying surplus statement.
>
> Practically the same situation of uncertainty as to the excess profits tax exists this year as last, and the company feels it unwise to estimate the amount of the tax which it will be required to pay upon its 1918 business. When the amount of this tax is definitely determined it will in turn be charged against the company's surplus.
>
> The income tax for 1917 was 6 per cent on the company's net income for that year. Under the tax bill just passed, and which is expected to be approved by the president, the company's income tax for 1918 will be increased to 12 per cent of its net income. Provision for this increase has already been made out of the company's income for 1918.

Reference was made to two reserves. The company has been creating a reserve over a period of years to establish a fire insurance fund. Since the date of its creation a portion of the fire risk has been carried by the company. The accumulation resulting is the amount of the premiums the company would otherwise have paid to insurance companies, plus what the fund has earned by way of income from its securities. The fire insurance fund reserve stood in the balance sheet as of Dec. 31, 1918, at $983,920. The company heretofore established a fund, called the service annuity fund, to aid faithful employees after they have served the company for a long period of years and have arrived at an advanced age. This fund stood at the close of the year at $569,095.

Operating revenue was $26,505,136, comparing with $25,351,585 in 1917. Operating expenses were $14,119,935, against $13,791,636. Charges for amortization and depreciation reserve were $2,822,090 in 1918 and $2,836,246 in 1917. The surplus available for dividends last year was $4,936,470 as compared with $4,677,077 in 1917.

GOVERNMENT LOAN TO HELP BUILD THE LORAIN PLANT

War Finance Corporation to Advance $500,000 Toward Cost of New Generating Station, Which Will Supply Shipbuilding Company

A loan of $500,000 has been made by the federal government through the War Finance Corporation to aid the Lorain County Electric Company in completing its new generating station at Lorain, Ohio. The loan is made to the Utilities Construction Company, which has a contract to build the plant. Work has been suspended on the station for some time on account of the difficulty of financing. The interest of the government lies in its desire to have sufficient energy to meet needs of the American Shipbuilding Company plant, which has contracts for the Emergency Fleet Corporation.

Efforts will be made now to finish the work in four months. The total cost of the plant, which will have a capacity of 10,000 kw., is estimated at $125,000. The Lorain company is a Doherty property.

CHANCE FOR WATER-POWER LAW IN LAST DAYS OF CONGRESS

Agreement Reached by the Conferess—Analysis of the Bill as It Stood After Conference Between Senators and Representatives

After seven years of debate and discussion the conferees on the water-power bill now pending in Congress obtained an agreement on Feb. 26. The principal delay in reaching an agreement, as has heretofore been reported by the Washington representative of the ELECTRICAL WORLD, arose from the inability of the conferees to reach a conclusion concerning the two mooted points as to whether or not there should be a federal power commission and whether or not there should be a charge against the companies which propose to construct hydroelectric plants.

Senator Bankhead has been the acting chairman of the water-power conferees of the House and Senate in the absence from illness of Senator Shields.

As soon as President Wilson returned to the United States Senator Bankhead drew the attention of the White House to the questions in difficulty between the House and the Senate conferees, with the result that President Wilson discussed the water-power legislative situation with the conferees at the White House on Tuesday, night, Feb. 25. It is well understood in Washington that if credit for reaching an agreement among the water-power conferees is due to any one, it is due to Senator Bankhead.

ANALYSIS OF THE AMENDED PROVISIONS

An analysis of the bill now about to be reported is furnished by the Washington representative of the ELECTRICAL WORLD, who reports, after conversations with Senator Bankhead, Speaker Clark and others, that there is a very fair prospect of the adoption of the report by the House and the Senate, perhaps before this is published. At the time this is telegraphed from Washington legislative leaders there hope that the House of Representatives will find time, with its crowded calendar, to accept the report, and over on the Senate side the statement is clearly made that if the bill comes to the Senate from the House by Friday the Senate will adopt it.

Speaker Clark, in discussing the possibility of this legislation with the Washington representative of the ELECTRICAL WORLD, on Wednesday night, remarked, "Better late than never," and he added that in his belief no one on the floor of the House of Representatives would attack the report of the conferees.

It must be considered, however, that the legislative situation in Congres is such that almost any bill, no matter of how great importance it may be, is liable to be sidetracked in favor of bills of a political character which members have a pressing personal interest in having passed.

In discussing the proposed water-power legislation with the Washington representative of the ELECTRICAL WORLD, Senator Bankhead said:

"The conference had before it the so-called Shields bill, which passed Congress twice, after very thorough discussion. That bill went over to the House. The committee to which it went struck out all after the enacting clause and wrote practically a new bill. When the altered bill finally passed the House of Representatives and was ordered to a conference the preliminary situation was as follows: Both the original Shields bill and the substituted House bill, the latter being called the administration bill, were in conference. It was the duty of the conferees to harmonize the two, taking the best features of each bill and weaving them into a new one which the conferees agreed on Feb. 26 to report. When this conference report comes from the House of Representatives it will occupy the status of privileged business in the Senate. Under the Senate rules conference reports are privileged and are taken up and acted upon immediately. If the conference report comes from the House we hope in the Senate to adopt it at once.

"We regret for the country's sake that we have had difficulty in reaching an agreement all these years. The main difficulty was that the House bill created a federal power commission, composed of the Secretaries of War, Agriculture and the Interior. To this commission every applicant for a license to construct power dams would have been and is required to apply for a license to construct, and permits would have been and are required in accordance with the limitations of this bill. That difficulty was overcome by the conferees.

"One of the other sharp differences among the conferees, and one which created more controversy than any other, was the provision in the House bill that authority be given to levy what was called a reasonable charge for the permits to be issued for the privilege to construct dams and other pertinent works. The Senate conferees were opposed to the imposition of this charge, but in order to obtain the passage of the bill they yielded to the House of Representatives. The House conferees agreed to the Senate recapture clause and the net investment provision of the bill. The recapture clause means that in case the government, before or after the expiration of the license which is to be issued, desires to take the property over it may do so, by paying the licensee the amount of the net investment determined by the books of the person concerned."

OTHER AMENDMENTS AGREED UPON

The subjects outlined in Senator Bankhead's statement as above constitute, of course, the principal subjects which have hindered an agreement by the conferees, but they also have recommended many amendments, some of which are digested below:

In the conferees' report it is provided that the clerical forces of the Departments of War, the Interior and Agriculture shall so far as practicable perform the work of the water-power commission. This apparently was done for the purpose of preventing the creation of a great new government department. The bill was also amended to define the word "corporation"; also it was amended to define the term "navigable water." Some importance was attached by the conferees to the definition of the word "navigation." The conferees' report says: "It is thought that 'government dam' is a more comprehensive and clearer expression of what is intended than the expression 'navigation dam.' The words 'the improvement of navigation' are

stricken out and the words 'government purposes' are inserted."

There are certain accounting requirements provided for in other amendments, also some specific requirements which deal with the matter of the majority of stock ownership and the question of the law under which corporations shall be organized.

One specification in the report provides that "in case the commission"—alluding, of course, to the federal power commission which it is proposed to create—"shall find that any government dam may be advantageously used by the United States for public purposes in addition to navigation, no license therefor shall be issued until two years after it shall have reported to Congress the facts and conditions relating thereto."

The conferees decided to alter the language in Section 7 of the bill, which deals with the question of licenses. The phrase "equally well" was used for the purpose of clarity of language by the conferees, and there were other alterations in wording so that the coming work of the federal power commission, in case the bill is passed, may be simplified. Other amendments by the conferees dealt with the question of mortgages and trusts on properties.

As to the amortization feature, the conference report has the following to say: "The bill as passed by the House provided that the amortization feature should be incorporated into the license from the beginning of the term of the grant. The House amendment as amended in conference provides that this amortization feature shall not become effective until after the expiration of the first twenty years of operation."

The conferees require that the proportion of charges to be paid by any licensee shall be determined by the federal power commission. The conferees suggest in their report that this provision of the law is made necessary in order to make that particular section of the law workable. The conferees declare in their report that there should be vested in the proposed federal power commission the right and authority to decide whether or not in Section 10 of the bill licenses shall be issued for a part only of a complete project, where the land of the United States required is to be used only for tranmission lines, water conduits or for storage reservoirs, of for a complete project of not more than 50-hp. capacity.

The conferees deem it proper that the proposed commission shall issue from year to year annual licenses to the then licensees under the terms and conditions of the original license until the property is taken over or a new lease entered into. They wish to amend the bill also to prevent the misunderstanding that expenditures for the construction of locks or other aids to navigation, or any other capital expenditures, were to have anything to do with the making of rates.

The method of application for constructing dams and other questions of an administrative character, which, of course, will very largely lie within the jurisdiction of the proposed federal power commission, are set forth.

Late advices from Washington, just before this issue of the ELECTRICAL WORLD went to press, were that the bill was expected to reach the House on Friday and that it was possible that the measure will reach the Senate this week.

NEW-BUSINESS OPERATIONS TO REOPEN IN NEW MEXICO

Sales Departments That Were Curtailed During War Will Be Re-established to Offset Losses Due to Daylight Saving and High Costs

The fifth annual meeting of the New Mexico Electrical Association, at Albuquerque on Feb. 17, 18 and 19, was, from all comments, the most successful convention ever held by that association. As to the prospects for the future a spirit of optimism prevailed throughout. Many of the central stations of New Mexico had discontinued practically all new-business activity during the war, but the expression of delegates at this convention indicated that all of them were returning to pre-war conditions and were reëstablishing their new-business departments. It was decided that the best plan to make up the loss of revenue caused by daylight saving was to put on extensive campaigns for socket appliances, electric ranges and motors.

A paper was read by W. C. Wurfel, Pacific Coast manager of the Westinghouse Lamp Company, on "Industrial Lighting." "Relations of Consulting Engineers to Public Utilities," by H. O. Duerr, consulting engineer of Albuquerque, N. M., brought out points in favor of employing consulting engineers in small central stations to check up operating and public policy conditions.

A paper on "Efficiency" by M. R. Buchanan, manager of the Silver City (N. M.) Power & Ice Company, contained some valuable suggestions on handling labor. "Some Considerations in the Use of Iron Wire for Alternating-Current Transmission," by Prof. R. W. Goddard of the New Mexico College of Agriculture and Mechanic Arts, contained a good deal of technical data with reference to capacity and resistance.

An interesting address with illustrated slides was given by H. L. Garbutt, manager of the line-material section of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., on the subject of "High-Voltage Pin-Type Insulators." The paper "Power Factor," by B. C. J. Wheatlake, of the General Electric Company, Denver, Col., was one of the most interesting papers of the convention.

"Prospects for the Year 1919," by W. P. Southard, manager of the Trinidad Electric Transmission Railway & Gas Company, Trinidad, Col., dealt principally with business conditions for the next year. A. C. Cornell, sales manager of the Western Electric Company of Denver, gave some interesting information relative to "Marketing Condition of Materials Used Principally in Central Stations."

"The Relation of the Manufacturer to the Utilities" was the title of a paper read by C. D. LeMoree of the Westinghouse Electric & Manufacturing Company of Los Angeles, Cal. D. W. Morgan, manager of the Las Cruces (N. M.) Light & Power Company, read an interesting paper on "Electrical Merchandising." M. E. DeFrance, manager of the Deming (N. M.) Ice & Electric Company, read a paper on "What the Electrical Association Means to Its Members and the Interest Each Individual Should Take."

J. D. Clark, professor of chemistry at the University of New Mexico, Albuquerque, read an interesting paper on "Knowledge That Pays Dividends."

Will the Consumer Balance the Scales?

UNITE MANUFACTURERS OF MATERIAL-HANDLING MACHINERY

New Association, with Headquarters in New York, Will Study Handling of Materials at Railroad and Ocean Terminals and Other Problems

The Material Handling Machinery Manufacturers' Association has been formed with the following officers: President, Calvin Tomkins, formerly Commissioner of Docks, New York City; vice-president, J. A. Shepard; treasurer, Lucian C. Brown; directors, Mr. Shepard, Mr. Brown, R. W. Scott, F. W. Hall, William Clark, J. C. Walter, C. M. Watson and Fred Stadelman. Four additional directors are to be chosen when the charter membership is completed. The active conduct of the association work will be in the hands, as secretary and manager, of Zenas W. Carter, formerly commissioner of the Associated Metal Lath Manufacturers, and previously field secretary of the Granite Paving Block Manufacturers' Association. Officers have been opened at 35 West Thirty-ninth Street, New York.

The new organization has been formed by the following, who are a membership committee to complete the charter membership:

Watson Elevator Company, Edward F. Terry Manufacturing Company, International Conveyor Corporation, Rownson, Drew & Clydesdale, Inc., New Jersey Foundry & Machine Company, Hayward Company, Elwell-Parker Electric Company, Sprague Electric Works, Otis Elevator Company, Manning, Maxwell & Moore, Inc., Robins Conveying Belt Company, Michener Stowage Company, New York City.

Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.

Brown Portable Conveying Machinery Cmpany, Chicago.

Karry-Lode Industrial Truck Company, Long Island City.

Whiting Foundry Equipment Company, Harvey, Ill.

Wellman-Seaver-Morgan Company, Cleveland, Ohio.

Alliance Machine Company, Alliance, Ohio.

Alfred Box & Company, Inc., Philadelphia.

Meade-Morrison Manufacturing Company, East Boston, Mass.

Alvey-Ferguson Company, Cincinnati, Ohio.

Heyl & Patterson, Inc., Pittsburgh, Penn.

American Hoist & Derrick Company, St. Paul, Minn.

Cleveland Crane & Engineering Company, Wickliffe, Ohio.

Clyde Iron Works, Duluth, Minn.

Ohio Locomotive Crane Company, Bucyrus, Ohio.

Northern Engineering Company, Detroit, Mich.

Electric Controller & Manufacturing Company, Cleveland, Ohio.

An announcement by the association says that the organization was effected following the suggestion of the Department of Commerce and the United States Shipping Board. The suggestion was made by the two government agencies because of the need for intensive study of the freight-handling methods at both railroad and ocean terminals.

While the immediate cause for organizing is the need for intensive study of the handling of materials at terminals, the body will take up the whole field of material handling and thus touch every industry.

In general the lines of work—technical, educational, promotional, etc.—will parallel those of other trade associations, but the nature of the problems will require more extensive technical committee work than is customary in such bodies. In one particular the proposed work presents an unusual phase. Since material-handling problems are found in every industry, relations will be cultivated with existing trade associations. Thus the material-handling problems of the various industries will come before broadly representative committees of material-handling experts. Already several of these coöperating committees have been arranged for, and excellent results from their work are expected.

AN INTERESTING FACTORY LIGHTING DEMONSTRATION

Simple Method of Showing Effectiveness of Different Lighting Layouts in Producing Illumination on the Working Plane

Another demonstrating model for bringing out the truth about industrial lighting was presented before the Chicago Section of the Illuminating Engineering Society on Feb. 20 by W. A. Durgin of the Commonwealth Edison Company.

This model was used in conjunction with an address in which the speaker presented data to prove the productive value of factory-lighting installations with intensities ranging up to 13 ft.-candles. Such installations, it is his belief, can best be made by the use of a general lighting system employing large lamps in industrial-type reflectors, with possibly a few shaded lamps on drop cords at machines requiring especial treatment. The model is used to show the effectiveness of such a general lighting system properly designed as against a system employing bare lamps or improperly designed reflectors. It consists of a miniature factory building in which lathes and other machine tools are mounted on the floor. Several different kinds of lighting systems are installed in the factory in miniature, including one of correct design.

This model is mounted on supports which place the factory floor at a height of about 8 ft. (2.5 m.) above the speakers' platform. In a vertical position beneath the miniature factory is mounted a white cloth which is to represent the "working plane" in the model factory. Other miniature lighting schemes behind this "imaginary working plane" are arranged to produce on the cloth effects which the audience can see that are identical with the effects that the various lighting systems in the factory would produce on the real working plane in the factory.

Operation of these systems of miniature lighting by an assistant to the speaker clearly illustrates the varying intensities that prevail in the factory under daylight conditions and under the inadequate artificial systems employing bare lamps. The even distribution that is obtained from large units in reflectors properly spaced is also shown in contrast. The whole demonstration is so simple that even the layman can understand better the technical phases of factory lighting after this model has been operated before him.

The detailed data which Mr. Durgin gave in his address are printed elsewhere in this issue in condensed form for the use of the lighting man. Discussion of his paper at the Chicago meeting was somewhat unusual in that it comprised little of the usual professional comment and that there was considerable discussion and questioning by the architects and users of industrial lighting systems. Some of these users of light insisted on discussing competitive types of equipment in defiance of the practice of the society.

COST OF BUILDING THE DAM AT MUSCLE SHOALS, ALA.

Data Printed in an Article Contained in the "Electrical World" of Feb. 8 Referred Solely to the Dam and Not to the Nitrate Projects

The following letter has been received from Maj.-Gen. C. C. Williams, Ordnance Department, United States Army:

Your attention is invited to page 281 of the ELECTRICAL WORLD of Feb. 8, 1919, and to an item entitled "Cost of the Muscle Shoals Nitrate Plant." The subject matter of the item is the same as that of the letter addressed to Nicholas Longworth by Benedict Crowell, the Assistant Secretary of War, regarding the building of a dam at Muscle Shoals, Ala., on the Tennessee River.

The nitrate projects in that neighborhood are not related to the dam at Muscle Shoals, and many statements have been made publicly which naturally confuse the dam with the nitrate projects. The ELECTRICAL WORLD has the reputation of accuracy, of which it is undoubtedly jealous, and the Ordnance Department is also interested in trying to see that all statements concerning its work in the war are as nearly accurate as possible. You will probably wish to correct the item referred to, which is correct with the exception that reference to nitrate projects should not have been made.

GOVERNMENT LOANS TO ASSIST EXPORT TRADE

Large Scope of Plan Under Which War Finance Corporation Would Have Authority for Lending $1,000,000,000 to Aid Export Business

A report on the Victory short-term notes bill, presented on Monday of this week before the House of Representatives by Chairman Kitchin of the ways and means committee, outlines the plan for making loans to assist export trade.

A section of the bill authorizes the War Finance Corporation to make loans to exporters and to banks, bankers and trust companies until one year after the termination of the present war to assist in the exportation of domestic products. Because of exchange conditions, thereby necessitating some of the foreign governments putting restrictions upon our exports to them, as it is claimed, it is believed that this provision will materially help our industries in their production during the transition period and to maintain their export business. Other particulars regarding the plan are explained in the report as follows:

This section authorizes the War Finance Corporation to make advances for periods not exceeding five years direct to any exporter engaged in the export business in the United States, if, in the opinion of the board of directors of the corporation, he is unable to obtain funds upon reasonable terms through banking channels.

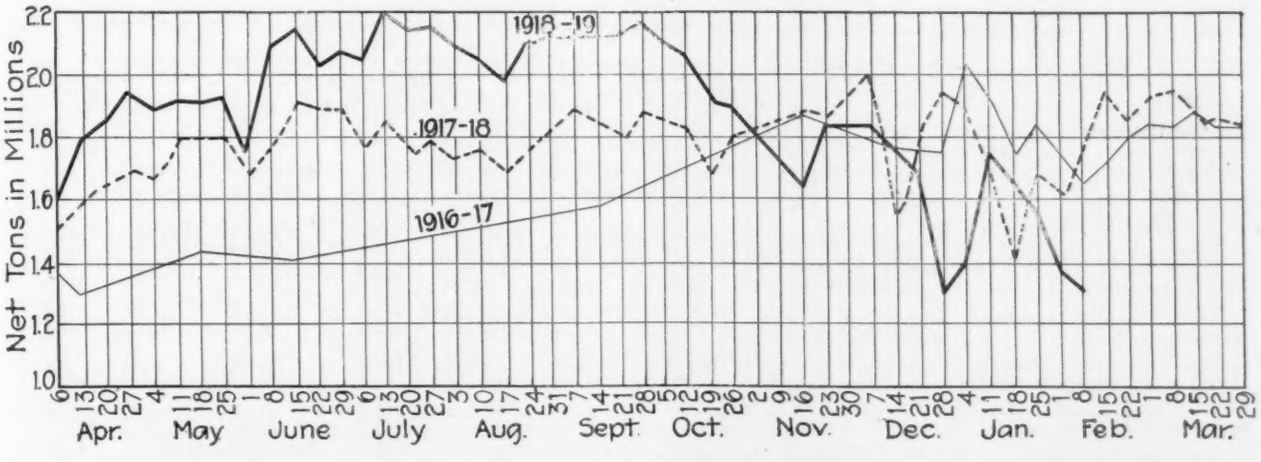
Any such advance shall be made only for the purpose of assisting in the exportation of such products, and shall be limited in amount to not more than the contract price therefor, including insurance and carrying or transportation charges to the foreign point of destination if and to the extent that such insurance and carrying or transportation charges are payable in the United States by such exporter to domestic insurers and carriers. The rate of interest charged on any such advance shall not be less than 1 per cent per annum in excess of the rate of discount for ninety-day commercial paper prevailing at the time of such advance at the Federal Reserve Bank of the district in which the borrower is located.

This section also authorizes the corporation to make advances for not to exceed five years to any bank, banker or trust company in the United States, which, after this section takes effect, makes an advance to any exporter for the purpose of assisting in the exportation of domestic products. Such advances are to be limited to not exceeding the amount remaining unpaid of the advances made by the bank, banker or trust company to the exporter for the purpose of exporting domestic products.

The corporation cannot have outstanding under this section and unpaid at any one time advances in excess of $1,000,000,000.

The corporation at the time of making any advance must require adequate security.

Declining Production of Bituminous Coal Mines in the United States



Estimates by the Geological Survey place production of bituminous coal during the week ended Feb. 8 at 8,040,000 net tons, which falls 291,000 net tons, or 3.5 per cent, below the production of the week of Feb. 1 and 2,521,000 net tons, or 24 per cent, below the corresponding week of 1918. The average production per working day during the current year is esitmated at 1,340,000 net tons, as compared with 1,860,000 net tons for the coal year to date and 1,744,000 net tons for a similar period of last year.

The production for the coal year to date, now estimated at 502,107,000 net tons, exceeds the production of last year for the same period by 31,129,000 net tons. A continuation of the low production recorded during the past few weeks for the rest of the coal year will cut this excess down approximately one-half, and production for the coal year ended March 31, 1919, will not exceed 565,000,000 net tons.

RETURN THE WIRE LINES, SAY STATE COMMISSIONERS

Net Result of Six Months of Federal Operation, They Declare, Is Inferior Service and Substantial Increases in Charges

A letter urging the ending of federal control of telephone and telegraph lines has been addressed to President Wilson and Congress by the National Association of Railway and Utilities Commissioners. The letter, signed by Charles E. Elmquist, president of the association, recommends the return of the properties after a conference of the executive and war committees of the association, which include members from practically all states.

A resolution is included recommending to the Postmaster-General that the federal control of the lines cease "as soon as practicable and the military necessity therefor shall have ended."

Among the reasons advanced by the letter are:

The net result of six months of operation by the Postmaster-General of these wire systems is inferior service and very substantial increases in charges to the public.

We feel that these properties should be returned. No military necessity can now be pleaded in support of government control. The quality of the service has in many cases deteriorated. No rule, regulation, practice or rate increase has been adopted for military purposes. Rates and charges have been greatly increased without giving the patrons or the public an opportunity to be heard as to the reasonableness or justice thereof, although the principle was long ago settled that important changes shall be submitted for public consideration before becoming effective.

These rate changes are applicable upon state as well as interstate traffic and have thereby caused widespread dissatisfaction with federal operation. . . . This toll rate order also prescribes a new and untried system which has resulted in general confusion among operating officials and the patrons throughout the country.

Fundamental changes are being made in the operation of these systems which probably could not be legally done under private control and which upon return to private management may cause serious disturbances in the relative status of the different wire systems. Federal operation also disrupted service and resulted in interfering with many of the established practices in forty-four states.

The Postmaster-General's recent declaration that employees engaged in the public service should receive higher compensation than those engaged in private service of a similar kind, which, as a matter of fact, can be accomplished only through rate increases, has caused a demand by the employees of the wire systems for largely increased wages.

Under the provision of the law that the President fix "just compensation for government use," the Postmaster-General accepted the proposal of the Bell system, which contained provisions very satisfactory to the company with respect to guaranteed return, recognition of securities as a basis of value, reservation of property by that system, the assessment of taxes and increased expenses.

In this connection, however, it may be pointed out that corresponding contracts proposed by the Postmaster-General to other companies contain elements much more protective of the public interest and are so different that they constitute a discrimination in favor of the Bell system as against other companies or systems.

Neither the advantage accorded to the Bell system, through its agreement, nor other forms of agreement, have been offered in whole or in part to the thousands of small companies confronted by existing financial, operating and tax problems.

Census Bureau Report of Electric Light and Power Stations—1917

Preliminary figures, published herewith, of the forthcoming quinquennial report on the central electric light and power stations of several states have been given out by Director S. L. Rogers of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of Eugene F. Hartley.

The statistics cover both commercial and municipal plants. They do not cover electrical plants operated by factories, hotels, etc., which generate for their own consumption, those operated by the federal government and state institutions, and those that were idle or in course of construction.

	Kentucky			Tennessee			Nebraska		
	1917	1912	Per Cent of Increase * 1912 to 1917	1917	1912	Per Cent of Increase* 1912 to 1917	1917	1912	Per Cent of Increase * 1912 to 1917
Number of establishments	125	89	40.4	106	90	17.8	297	174	70.7
Commercial	103	73	41.1	70	60	16.7	148	112	32.1
Municipal	22	16	37.5	36	30	20.0	149	62	140.3
Income	†$4,436,445	†$2,754,115	61.1	‡$4,937,285	‡$2,448,218	101.7	¶$4,860,874	¶$2,802,614	73.4
Electric service	$4,334,938	$2,683,137	61.6	$4,877,359	$2,408,762	102.5	$4,640,262	$2,678,240	73.3
All other	$101,507	$70,978	43.0	$59,926	$39,456	51.9	$220,612	$124,374	77.4
Total expenses, including salaries and wages	$3,531,547	$2,244,906	57.3	$4,436,698	$1,753,875	153.0	$3,911,923	$2,239,542	74.7
Number of persons employed	1,031	907	13.7	1,008	656	53.7	1,227	882	39.1
Salaries and wages	$759,383	$635,829	19.4	$777,922	$455,212	70.9	$979,345	$598,703	63.6
Total horsepower	98,752	81,767	20.8	201,912	68,994	192.7	112,103	52,168	114.9
Steam engines:									
Number	165	171	—3.5	129	130	—0.8	187	156	19.9
Horsepower	96,066	81,191	18.3	69,679	40,799	70.8	89,119	42,452	109.9
Internal-combustion engines:									
Number	63	6	850.0	18	4	350.0	281	91	208.8
Horsepower	2,301	576	299.5	581	445	30.6	12,480	3,832	225.7
Waterwheels:									
Number	7	.....	.....	57	32	78.1	57	44	29.5
Horsepower	385	.....	.....	131,652	27,750	374.4	10,504	5,884	78.5
Kilowatt capacity of dynamos	69,442	54,062	28.4	145,335	49,640	192.8	78,227	34,586	126.2
Output of stations, kilowatt-hours	122,630,433	75,593,179	62.2	564,914,272	75,544,893	647.8	129,531,131	56,299,682	130.1
Stationary motors served:									
Number	9,192	4,106	123.9	3,516	1,720	104.4	7,842	3,575	119.4
Horsepower	63,784	22,621	182.0	43,213	20,357	112.3	57,435	26,325	118.2
Number of street lamps:									
Arc	6,757	7,332	—7.8	2,861	3,938	—27.3	178	2,451	—92.7
Incandescent, etc	10,890	5,278	106.3	15,099	6,732	124.3	27,752	12,149	128.4

* A minus sign (—) denotes decrease.
† Exclusive of $153,411 in 1917, and $103,324 in 1912, reported by electric railway companies as income from sale of electric energy.
‡ Exclusive of $2,073,731 in 1917, and $1,372,745 in 1912, reported by street and electric railway companies as income from sale of electric energy.
¶ Exclusive of $469,481 in 1917 and $130,958 in 1912, reported by street and electric railway companies as income from the sale of electric energy.

Associations and Societies

The Directory of Electrical Associations, which is regularly printed in the first issue of each month, appears on page 459 of this number.

N. E. L. A., Philadelphia Electric Company Section.—At the Feb. 25 meeting of the commercial branch section "The Consumer's Installation" was the topic discussed by P. H. Bartlett.

Wisconsin Electrical Association.—From March 25 to March 27 the annual meeting of the Wisconsin Electrical Association will take place in Milwaukee. J. P. Pulliam, 1408 First National Bank Building, Milwaukee, is secretary of this organization.

A. S. M. E., Birmingham Section.—On March 5 the Birmingham Section of the American Society of Mechanical Engineers will hear Prof. H. L. Freeman, Mississippi Agricultural and Mechanical College, on "The Preparedness of Technical Graduates for Industrial Work."

New York Electrical Society and Institute of Radio Engineers.—In the Engineering Societies Building, New York City, on March 5, Roy A. Weagant, chief engineer of the Marconi Wireless Telegraph Company of America, will present a paper entitled "Reception Through Strays and Interference" before a joint meeting of the Institute of Radio Engineers and the New York Electrical Society.

N. E. L. A., Pacific Coast Section.—The next convention of this section is to be held in the Hotel del Coronado near San Diego, Cal., from April 30 to May 2 inclusive. At the same time and place the California Association of Electrical Contractors and Dealers and the Pacific Coast Electrical Supply Jobbers' Association will hold their regular quarterly meetings. The Westinghouse Jobbers-Agents' Association is planning to attend this meeting in addition to holding its own meeting at Del Monte the week following.

American Electrochemical Society, Pittsburgh Section.—Below is a partial list of the subjects and speakers at the March 14 meeting of the Pittsburgh Section of the American Electrochemical Society: "The Power Situation in the Pittsburgh District," G. G. Bell of the West Penn Power Company; "Commercial Aspects of the Power Situation in the Pittsburgh District," C. S. Cook, general manager Duquesne Light Company; "Electric Steel Furnaces," W. E. Moore and John Coyle, general manager Hussey-Bins Steel Company; "Manufacture of Ferro-Alloys in the Electric Furnace," A. C. Cummins, superintendent of ferro-silicon and electrode departments, Carnegie Steel Company, Duquesne Works; "Electrolytic Plants in the Pittsburgh District," Dr. C. S. Palmer; "Electrolytic Recovery of Copper and Sulphuric Acid," C. E. Skinner, head of research laboratory, Westinghouse Electric & Manufacturing Company; "Electrostatic Precipitation in the Smelting Industries," C. S. Barnham, general superintendent Pennsylvania Smelting Company, Carnegie, Pa.

New York Electrical League.—This is the new name of the organization formerly known as the New York Jovian League. The change was made at the Feb. 18 meeting of the society, at which time all connection with the Jovian Order was severed and a new constitution was adopted. It is now unnecessary for a member of the league to be a Jovian. Still further expansion is planned by the league and efforts will still be made to determine the advisability and best methods of starting a New York Electrical Board of Trade wherein all branches of the industry will be represented. For the purpose of gathering information and making suggestions to the advisory committee of the league a committee was appointed consisting of a representative from a manufacturer, an electrical contractor, a jobber and a public utility. There is some difference of opinion as to the best method of handling meetings. Some members think that electrical trade subjects should be discussed at the monthly luncheon, whereas others are of the opinion that broad subjects taken up by distinguished speakers as heretofore will be the best method of gaining a large audience and promoting good fellowship among the electrical fraternity.

American Institute of Electrical Engineers

Panama Section.—A paper on "The Influence of Modern Illuminants Upon Industrial Economy and Efficiency" was presented at a recent meeting by L. W. Lewis, electrical designer for the Panama Canal.

Washington Section.—On Feb. 11 H. A. Hornor gave a lecture on "Electric Welding in the Ship Industry." Lantern slides illustrated some recent applications of this art, and a demonstration was also given with a modern outfit.

Ithaca Section.—On Feb. 7 Prof. Frederick Bedell spoke on "Airplane Performance" and Prof. W. C. Ballard had for his subject "Some Recent Developments in Radio Communication," the latter talk being illustrated with apparatus.

Portland (Ore.) Section.—The Portland Section of the Instiute held a joint meeting with the local section of the National Electric Light Association on Feb. 4 to hear a paper on "Placing a Deep-Water Submarine Telephone Cable," by R. H. Sheppard of Seattle. Slides and moving pictures were used to show how the longest submarine cable on the Pacific Coast was laid across Puget Sound.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Use of Municipal Bonds.—A statute authorizing any city or village to issue and sell bonds for the purpose of providing necessary funds to pay the cost of acquiring by purchase or otherwise a waterworks plant and a water supply, and to construct, enlarge, extend, repair, alter and improve such plant, also to issue bonds in sufficient amount to acquire by purchase or otherwise a light and power plant, does not authorize such municipality to issue and sell bonds for the purpose of providing necessary funds to pay the cost of enlarging, extending, repairing and improving a light and power plant which it owns, the Supreme Court of Idaho held (177 P. 388).

Taxation Restrictions.—As the law forbids cities from levying any license taxes in excess of one-half of 1 per cent upon corporations furnishing water, heat, light or power, it was held by the Supreme Court of Appeals of Virginia (975 E. 780), in City of Lynchburg versus Lynchburg Traction & Light Company, that though a previous franchise ordinance accepted by the predecessor of a company engaged in transporting passengers and furnishing light reserved the power to tax the property of the company and to levy a license tax, the city could not levy a license tax on the company's street-railway business or a license tax upon its business of furnishing light etc., in excess of the amount allowed by statute, on the ground that the license charges were compensation for use of the streets.

Taxation of Utility Property.—In assessing the capital stock of an electric light and street-railway corporation under code, the indebtedness of the corporation cannot be deducted from the value of the stock, the Supreme Court of Iowa held in Marshalltown Light, Power & Railway Company versus Welker (170 N. W. 384). In assessing the capital stock of a corporation where the corporate property consisted exclusively of real estate and other tangible property, indebtedness should be taken into account in determining the value of the capital stock, even though it could not be deducted, for the market value of shares of stock would be somewhat affected by the amount of indebtedness, and, for the same reason, the dividends, etc., should be considered. As assessment of the capital stock of a gas, electric light and street-railway corporation at $150,000, pursuant to code, whose tangible property was valued by the assessor at $177,000 should be reduced to $73,000.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Success of Radio-Controlled Torpedo.—Secretary of War Baker has written to the appropriations committee of the House of Representatives that the joint Army and Navy Board has approved the device of John Hays Hammond, Jr., for radio control of surface craft to be sent laden with explosives against enemy warships. Successful results are also predicted with submerged craft on which only the wireless antennas will be above water. Mr. Hammond told the committee that he had spent ten years and $400,000 on his invention. Before deciding to purchase the patents for $750,000 the written to the appropriations committboard wants to experiment further. An appropriation for an experimental submerged boat is carried in the new appropriation bills.

Colonel Byllesby Defends Private Ownership.—Colonel H. M. Byllesby in a telegram to the Oklahoma Utilities Association in convention at Oklahoma City said: "It seems to me that only two courses are open to the utility business—first, that the laws be so adjusted as to allow these companies to make such a fair return upon their investment as will enable them to find capital continuously for the further extension of their enterprises which the growth of the community served and the improvements in the art render increasingly necessary. These laws and regulations at the hands of commissions or other properly authorized bodies should encourage in every proper way the spirit of enterprise and provide some profitable return beyond the mere bare interest on the cost of the properties in order to bring to bear the very best inventive and enterprising capacities. If the laws and regulations cannot provide for this situation, then the only alternative, it seems to me, is that the various communities should take over the properties at a fair and suitable compensation to the owners, as I am confident that at bottom no real American wishes to rob any one or to take possession of any property without making due, proper and fair payment therefor. This latter course is one which I sincerely trust will not be adopted, as it involves all the evils which years of experience have shown always attach to governmental operation of enterprises of this nature. The very best results to the community, to those who pay for the service rendered, will be found as always in private ownership, where this ownership, while being regulated along proper lines, is still allowed full scope for the exercise of ingenuity and enterprise."

American Cities Company Difficulties.—Following the appointment of receivers for the New Orleans Railway & Light Company, the Birmingham Railway Light & Power Company and the Memphis Street Railway Company, a protective committee for 5/6 per cent collateral trust bonds of the American Cities Company issued a statement saying in part: "The War Labor Board at Washington raised the wages of the various employees of several of the companies to such an extent that the net earnings were greatly reduced and the credit seriously impaired. These wages have been placed so high that it seems impossible to restore the net earnings of the companies, and thereby the credit of the companies, unless relief is obtained from the authorities controlling the rates for street railway fares, gas and electricity in cities where the several properties involved are located. The committee believes that with an earnest effort the companies will be granted an increase in income at least sufficient to meet the increase in wages authorized by the War Labor Board, and thereby further complications be avoided."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Lafayette Company May Increase Its Power Rate.—The Indiana Public Service Commission has granted the Northern Indiana Gas & Electric Company permission to increase temporarily its rates for service to large consumers of electric service. At the same time the commission denied the company's petition for a general increase in electricity rates and for increase in hot-water-heating rates. The company was granted permission to add ¼ cent per kilowatt-hour for consumption of from 400 kw.-hr. to 2500 kw.-hr. per month and ½ cent per kilowatt-hour for consumption of more than 2500 kw.-hr. per month.

Status of Competitive Company.—A decision by the New York Public Service Commission, Second District, raises again the position of the Lawrence Park Heat, Light & Power Company as a competitor of the Westchester Lighting Company in Bronxville. It says in part: "We are of the opinion that the present electric lighting business of the Lawrence company is of the nature of public service. The Public Service Commissions law was intended primarily for the protection of the patrons of companies and individuals furnishing various classes of service to the public. We do not believe that under that statute to sustain the character of public service the utility most be one which is offered to the public indiscriminately, which has been the test applied in some of the states, nor that the making of special contracts by the producer upon its own terms necessarily robs it of its public character. . . . Unless the service for which the permit is to be used is a public service, a certificate of public convenience and necessity as prayed for would be a contradiction in terms. We have determined, however, that the proposed service is of a public character, and we must next determine whether or not the certificate shall be granted. In the consideration of this question we are met with the objection that the village of Bronxville is not named in the certificate of incorporation of the Lawrence company as one of the towns, villages or cities in which the operations of the corporation are to be carried on, as required by the provisions of Section 60 of the transportation corporations law. The certificate does name the town of Eastchester within the boundaries of which the village of Bronxville lies. But every village lies within a town, and the statute requires that the village shall be named. . . . It seems clear, therefore, that the corporate rights of the Lawrence company do not extend into the village of Bronxville. . . . This objection can be overcome, however, by the petitioner amending its certificate of incorporation so as to include the village of Bronxville, and in order that this controversy may be finally disposed of we are inclined to consider the application on its merits at this time with the same effect as though that had been done, provided that the petitioner desires to so amend its certificate. It is clear that the adjudication of Oct. 9, 1917, contemplated that the Westchester company should be fully protected in the public and general commercial lighting of the village, and that the Lawrence company should be allowed to continue such lighting as it was then conducting, and with that disposition of the matter we are in full accord. The use of the permit in question will not in any way alter the adjustment thus made because it simply furnishes a more convenient way, both from the view of the company and that of the public, of conducting electric current to the Colonial Building and the Brick Row than is afforded by the two wires crossing Pondfield Road, the permit being limited to these purposes. The village authorities have expressed their preference for this method of transmission. An order will be entered denying the petition and directing the petitioner to discontinue operating under the permit described in the petition, unless within thirty days the petitioner files with the commission evidence that it has duly amended its certificate of incorporation by including the village of Bronxville in the towns, villages, cities and counties in which its operations are to be carried on, and provided that in case of such filing within thirty days the approval prayed for will be granted."

W. F. Gilman has been made district manager for the Central Illinois Public Service Company, with headquarters at Mattoon.

H. L. Wills has been appointed engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, Ga.

Lawrence A. Coleman, who has been assistant secretary of the United Electric Light & Power Company of New York City, has recently been appointed treasurer of that company.

W. G. Lord, formerly chief electrician of the Arkansas Valley Railway Light & Power Company, Pueblo, Col., has been appointed superintendent of the Pueblo division, succeeding **C. A. Orr,** resigned.

H. C. Deffenbaugh, who since last summer has been a first lieutenant in the Engineer Corps, has received his discharge and returned to the Empire State Gas and Electric Association, where he is assistant to the secretary.

T. T. Parker, for the last three years manager of the Union City (Ind.) Electric Company, has been appointed manager of the Kansas Electric Utilities Company, Emporia, Kan. The latter company operates the electric and railway systems in Emporia.

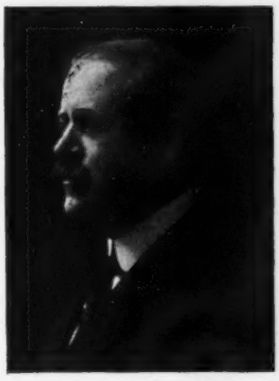
Alfred C. Wilson has resigned as engineer of the electrical department of the Georgia Railway & Power Company, Atlanta, to become associated with the Southeastern division of Lockwood, Greene & Company as assistant electrical engineer. Mr. Wilson was employed by the Georgia company for more than fifteen years, having entered the company's service following his graduation from the Georgia School of Technology.

Gardner F. Wells, who has been until recently manager of the division of transportation of the United States Housing Corporation, has resigned to enter the consulting engineering field, paying particular attention to public utilities. From 1901 to 1916 Mr. Wells was with Stone & Webster. For the first five years of this period he was engaged in property management and in engineering and construction work, and after that he was an appraisal expert, making office and field examinations and preparing reports of appraisals of public utilities. Before joining Stone & Webster he spent ten years with the Thomson-Houston and General Electric companies on engineering construction and management work in connection with electric light and other utility properties, going with the first-named company from the Massachusetts Institute of Technology, where he spent a year in engineering study. Since March, 1916, he has been head of the corporation bond-buying department of Arthur Perry & Co., Boston, and during the war period served first as major in the Ordnance Department of the army and later on the staff of Otto M. Eidlitz, head of the government Bureau of Industrial Housing and Transportation.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

Louis A. Ferguson, vice-president of the Commonwealth Edison Company, Chicago, is receiving the congratulations of his friends on having completed thirty years of service with the company and its antecedent companies. Mr. Ferguson has spent his entire business career as a central-station man. Promptly after graduation from the Massachusetts Institute of Technology in 1888 he entered the employ of the Chicago Edison Company. After serving in the underground department and in the trouble department, he was assigned to the electrical engineer's office,



L. A. FERGUSON

and in 1890 he became electrical engineer for the company. In 1897 he was appointed general superintendent in charge of all the electrical engineering, construction, operating and contracting of the company. Upon the formation of the Commonwealth Electric Company Mr. Ferguson was made its general superintendent. In 1902 he was appointed second vice-president of the Commonwealth Electric Company and the Chicago Edison Company. Five years later these companies were consolidated under the name of the Commonwealth Edison Company and Mr. Ferguson was elected second vice-president. In 1914 he was elected vice-president in charge of contract, operating, construction and electrical departments, a position which he still holds. To Mr. Ferguson belongs the credit of being the first central-station engineer in the United States to recommend the system of generating three-phase alternating current for distribution over transmission lines to substations containing rotary converters to transform the energy into direct current for general distribution. He has made three trips to Europe to study engineering development there. One of these investigations of European practice resulted in recommendations to the Chicago Edison Company that it adopt the differential rates now so largely employed. Mr. Ferguson is a past-president of the Association of Edison Illuminating Companies, the National Electric Light Association and the American Institute of Electrical Engineers. During the war he has been a member of the Federal Capital Issues Committee and other war bodies.

Obituary

Charles S. Hall, aged forty-six, who was treasurer and general manager of the William Hall Electric Company, 115 East Third Street, Dayton, Ohio, died on Feb. 16. The William Hall Electric Company is well known throughout the Middle West as a retail and wholesale distributer of electrical merchandise in the Miami Valley.

Edwin Appleton Record, manager of the electrical department of the Vacuum Oil Company, Boston, Mass., died recently at his home after a short illness. He was a native of Moncton, N. B., and in early life was engaged in foundry and machine work and then in the lumber trade. He had been connected with the Vacuum Oil Company for about thirty-four years and was in charge of the company's branch office business in all parts of the world.

A. O. Dicker, district manager for the Luminous Unit Company at Chicago, died of influenza on Feb. 15 after a brief illness. Mr. Dicker was a graduate of the University of Michigan in the class of 1910. After leaving school he became illuminating engineer for the contract department of the Commonwealth Edison Company. In June, 1914, he, together with some of his business associates, formed a new company called the Electrical Sales Engineers, Inc., of which he became secretary-treasurer. Later he joined the sales staff of the Luminous Unit Company, on which he was engaged at the time of his death.

D. L. Reynolds, member of the Graham-Reynolds Electric Company, electric supply jobber of Los Angeles, Cal., died recently from pneumonia following influenza. Mr. Reynolds was born at Pasadena, Cal., and when only seventeen years old came East to study dentistry, graduating in 1901 from the Baltimore Dental College. After four years of practice at Pasadena his health required him to give up his profession, and he became interested in the electrical business through his brother, Robert L. Reynolds, and soon after became a member of the Holabird-Reynolds Electric Company, now the Graham-Reynolds Electric Company, in which for fifteen years he had been associated with N. W. Graham.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

FARM-LIGHTING DISTRIBUTERS ARE NOW BEING STOCKED UP

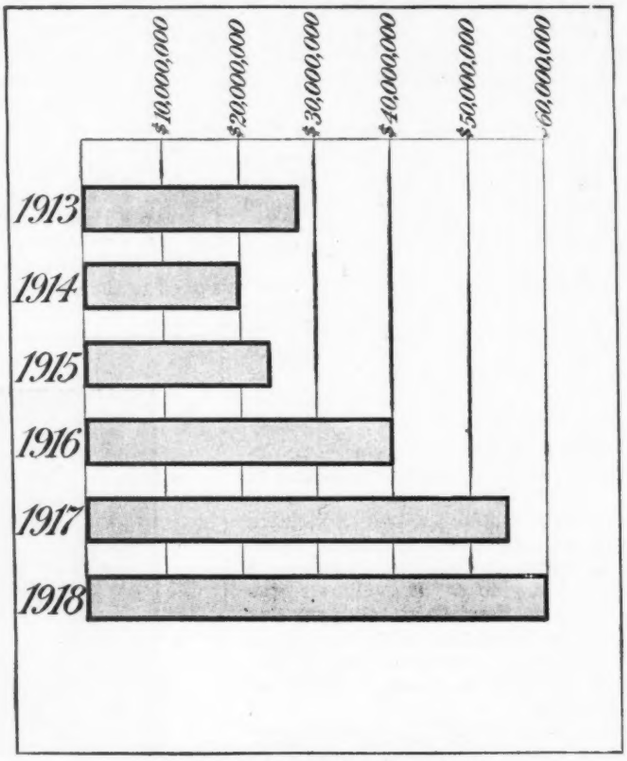
Reports State that Farmers Are Holding Back, Waiting for Lower Prices, of Which There Is No Present Indication

It is the opinion in some quarters that many of the farm-lighting plants which are apparently sold are not going to farmers. They are being used to load up wholesale distributers and dealers with stock which they can ill afford to carry. Meanwhile the farmers are waiting for decreased prices. There is, of course, no logical reason based on costs of material and labor to expect a decrease in price of farm-lighting plants at a reasonably near future date. If quantity production is maintained and if the farmers continue to hold off, the overproduction may create a market in which there will be reduced prices. It is reported that certain distributers of farm-lighting plants among the automobile trade have gone into bankruptcy on account of the overstock of farm-lighting plants which they were carrying. The cause of this is thought to lie in the method of doing business along lines usually followed by automobile manufacturers; that is, of shipping goods sight draft, bill of lading attached.

1918 SETS NEW RECORD FOR ELECTRICAL EXPORTS

Equipment Valued at $59,982,526 Shipped During the Year—Doubtful, However, if Volume of Goods Equals That for 1917

Exports for the last calendar year 1918 amounted to $59,982,526, which is larger than the value of electrical goods exported during any previous year. With the exception of batteries, insulated wire and cable, arc lamps, carbon lamps and telegraph apparatus, all of the items listed were exported in greater value last year than in 1917. It must not be forgotten, however, that the average price of copper wire was considerably less in 1918 than it was in 1917. Other items increased in price considerably during the year, and if this is taken into consideration when comparing 1918 figures with 1917, it seems doubtful that the volume of goods exported in 1918, therefore, was as great as that in 1917. The total value for 1918 was but 10 per cent greater than the total for the year before, but it is probably true that the average increase in price of electrical goods during 1918 was considerably more than 10 per cent.



SIX YEARS OF ELECTRICAL EXPORTS

The figures as here reported also include the figures for December, 1918, which amounted to $5,187,981, or a little more than $500,000 below December of the previous year. In view, however, of the signing of the armistice in November, this figure for last December is especially good.

Articles	December, 1917	December, 1918	1913	1914	1915	1916	1917	1918
Batteries	$370,486	$233,321	$359,123	$635,522	$1,364,999	$2,025,250	$3,624,222	$3,178,437
Carbons	178,567	139,347	.....	.....	.....	.....	*736,717	1,600,920
Dynamos or generators	138,450	344,034	2,374,122	2,372,816	1,872,191	1,867,565	2,356,780	3,363,349
Fans	73,106	88,678	415,774	295,966	374,113	313,771	622,731	847,327
Heating and cooking apparatus	58,701	74,794	.....	.....	.....	.....	1,256,533	686,339
Insulated wire and cable	676,651	465,688	*1,256,865	1,321,451	2,761,609	4,943,577	7,187,951	5,604,114
Interior wiring supply, including fixtures	134,398	100,270	*408,253	591,136	882,981	901,657	1,405,772	1,428,615
Arc lamps	1,534	128	134,053	42,782	23,968	15,467	16,418	14,139
Carbon-filament lamps	27,172	13,809	254,893	88,025	150,111	124,776	187,876	102,872
Metal-filament lamps	341,086	229,903	301,791	278,061	873,862	1,420,309	2,884,675	3,369,192
Magnetos, spark plugs, etc	328,527	318,005	.....	.....	.....	.....	*1,757,848	2,749,705
Meters and measuring instruments	191,539	122,311	.....	*157,386	657,129	884,241	1,213,278	1,887,925
Motors	730,585	663,216	4,886,508	3,300,839	3,279,174	4,932,831	6,484,972	8,225,197
Rheostats and controllers	21,641	27,850	.....	.....	.....	.....	*93,612	288,757
Switches and accessories	221,022	151,786	.....	.....	.....	.....	*1,025,003	2,195,300
Telegraph apparatus, including wireless	44,644	68,090	147,233	93,563	136,890	209,343	555,703	378,806
Telephones	278,162	121,935	1,659,326	1,251,788	910,562	1,813,969	2,212,237	2,687,483
Transformers	213,243	195,180	872,661	934,312	704,373	1,051,168	1,747,884	3,528,673
All others	1,696,862	1,829,636	15,126,761	8,599,468	10,316,548	19,740,151	21,107,867	17,845,376
Total	$5,726,376	$5,187,981	$28,197,363	$19,963,115	$24,308,510	$40,244,075	$55,478,079	$59,982,526

* Figures begin with July.

Numbers of American manufacturers of electrical goods received cancellation orders from abroad almost immediately upon the signing of the armistice, and consequently December shipments were considerably below what they would have been had the war continued. While it is true that export embargoes were generally lifted, still Europe had not entirely lifted its embargo on imports, and, moreover, there was not sufficient time after the signing of the armistice for business to develop in any volume. The exports in individual items ran along about average for the year, and there is nothing of especial interest to point out in the December figures.

The figures in the accompanying table were originally compiled by the Bureau of Foreign and Domestic Commerce and have here been brought together in order that comparisons may be made over a period of years. The totals for the last six years are graphically represented in the accompanying chart.

METAL MARKET SITUATION

Prices Generally Lower—Government Expects to Return Its Metals to Market for Easy Absorption

The tone of the whole market has undergone little change. Although the prices of many metals have continued in a steady downward trend, this has, as a rule, meant little to the trade because there were so few buyers and so few orders that the asked prices would have given way to almost any reasonable offer.

The War Department authorized a statement to the effect that, although details of the arrangement have not yet been worked out, it was practically agreed that some arrangement could be made between the War Department and producers of copper, lead and brass which would permit of a gradual feeding into the market of the surplus supply of these metals in possession of the War Department in such a manner as to obtain fair prices for the government without upsetting the market.

The 1,000,000,000 lb. of copper stocks in the United States comprises copper in the crude form and in the processes of refinement. Normal stock is 500,000,000 lb. Electrolytic copper quotations have declined about 1¼ cents from a week ago to 15.37 cents. Smaller producers, however, have made sales as low as 15 cents, but even this price has attracted little buying.

Lead has advanced from 5 to 5.25 cents per pound, and outside dealers have received as much as 5.30 cents.

American brass has dropped its base price for finished goods to a 17-cent copper level.

The used metals have continued to decline, and although orders are small, nevertheless the trade seems to be enjoying a better feeling.

NEW YORK METAL MARKET PRICES

	Feb. 18	Feb. 25
Copper:	£ s d	£ s d
London, standard spot	74 10 0	75 0 0
	Cents per Pound	Cents pr Pound
Prime Lake	17.50 to 18.00	16.50
Electrolytic	16.75	15.37½
Casting	16.50	15.25
Wire base	20.75	18.75 to 19.00
Lead, trust price	5.00	5.25
Antimony	7.25	7.12½
Nickel, ingot	40.00	40.00
Sheet zinc, f. o. b. smelter	11.00	11.00
Spelter, spot	6.72½	6.65
Tin	Govt. price 72.50	Govt. price 72.50
Aluminum, 98 to 99 per cent.	31.50	31.50

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	14.50 to 14.75	13.50 to 14.00
Brass, heavy	7.75 to 8.00	7.50 to 7.75
Brass, light	6.50 to 6.75	6.00 to 6.50
Lead, heavy	4.00 to 4.25	4.25 to 4.50
Zinc, old scrap	4.75 to 5.00	4.75 to 5.00

THE WEEK
IN TRADE

IN THE Far West stocks are getting pretty sizable, but elsewhere they are being kept pretty low. In fact, in some lines in certain localities stocks have been allowed to become too low.

Business of a small kind is keeping the trade fairly well engaged. Until prices have hit pretty near their low level it is doubtful if orders will be placed for large quantities of supplies except where immediate consumption is assured.

Prices generally are steady. Local prices show changes not registered elsewhere. Wire appears to be the only product from jobbers' stocks that is dropping in price everywhere.

It is announced from the office of the director of sales, War Department, that, as of Dec. 31 inventories, it has on hand $200,000 worth of miscellaneous electrical equipment exclusive of machinery.

Labor is still in a very uncertain state. Higher wages are being paid in spite of the surplus of labor. In fact, it would not be surprising to find labor prices increase for some time.

Collections appear to be in good shape—much better in fact than could reasonably be expected under the circumstances.

The General Electric Pittsfield works on Monday reduced the working week from fifty to forty-five hours, or five days of nine hours each. About 4000 hands are affected. This is the first time since August, 1914, that slack business has caused curtailment of working hours.

NEW YORK

The real estate market has shown no decided improvement this week. Plans suggested for writing off the present abnormal cost in building construction and encouraging private owners to make investments comprise temporary exemption of improvements from taxation, government aid on long-term loans and assistance for experiments in quantity production. A cessation of price fixing as a means to the return of normal conditions and the construction of public buildings the cost of which has already been appropriated have been advocated. The building during January, however, showed an improvement over December, and operations projected in January show an advance over that month of 1918.

Regardless of the new building field, jobbers report a very fair amount of work on hand, the business in January being better than that of the previous January. Stocks have moved down to a very satisfactory level so that overstocking has practically disappeared. Jobbers are not restocking to any considerable amount in the ordinary run of schedule and wiring material, but are keeping well up for the class of work that has been coming through.

Prices on rubber-covered wire base have eased off slightly, while transformers and regulators are lower.

Manufacturers' and jobbers' collections have been reported exceptionally good for the month of January. Credit is very satisfactory. Collections have been running well under sixty days, and some have been reported averaging forty-five days.

RUBBER-COVERED WIRE.—The average base has decreased about three-fourths of a cent, from 23.8 cents to 23.1 cents. One manufacturer quotes on 25-cent base this week as against two last week, and seven on 23-cent base against four last week. One is on 24-cent base, two on 22 cents, and one on cost.

TRANSFORMERS.—Two large manufacturers have quoted lower prices since the middle of February on trans-

formers of 200-kva. capacity and larger. The reduction was from 10 to 15 per cent in one case and 10 per cent in the other. Deliveries about ten weeks.

VOLTAGE REGULATORS.—About Feb. 1 prices of two manufacturers were reduced 5 per cent.

LAMPS.—While the 100-watt vacuum-type Mazda has been standardized with an unskirted medium through base with the same over-all dimensions as before, it will be possible for a considerable period of time to secure the skirted-base lamps in this size, owing to stocks on hand. The unskirted base, however, will become standard upon the disappearance of lamps of the other type now in stock. Both styles are listed at the same price.

CONDUIT.—Carload lots are coming through to the jobbers in good shape. Half-inch continues the favorite, but one jobber reports good 2½-in. sales, presumably indicating larger-size work, under way.

FLEXIBLE METALLIC CONDUIT.—A good movement is reported with no evident expectation of an early easier price. Considerable remodeling and recircuiting is providing a good part of the push for this material.

HEATER CORD.—Deliveries are much better, and stocks are in good condition.

SCHEDULE MATERIAL.—Surplus stocks have been reduced so that now they are in general very satisfactory to handle the fair amount of business coming through.

LAMP CORD.—A good market is reported with good local stocks and satisfactory deliveries from factories.

SOCKET DEVICES.—One large jobber reports very good sales of small-motor devices and table utensils.

FANS.—Jobbers are receiving their fan information. Some dealers have already placed their orders, and from inquiries and orders received one jobber predicts no decrease in fan business due to the higher prices for this year.

BOSTON

Trade is rather quiet this week. Washington's Birthday and the debarkation of President Wilson at Boston protracted the week-end. Inquiries are still in good volume, but buyers continue to play a waiting game. Labor conditions are very unsettled in the textile field. The danger of a telephone strike is lessened for the moment. Jobbers' stocks are being gradually reduced, and some scarcity in weatherproof wire is reported. Wire softened about 2 cents a pound last week in sympathy with the weakening of copper prices. The demand for appliances is healthy. Building operations look a little more promising. There will be a school to cost $150,000 erected soon at Quincy Point, and at Springfield it is estimated that about $2,000,000 of additional construction will be put through in 1919. Reduction of orders has led to a curtailment of the hours of labor at the Pittsfield (Mass.) works of the General Electric Company from 50 to 45 per week, with the exception of the fan-motor department, which will run on full time for the present. Collections are fair, especially when watched carefully. One jobber who pays personal attention to credits and whose invested capital is relatively small has reported good collections for many months past. It is rumored that storage-battery prices are likely to show further declines in the not distant future. Central stations have not as yet begun expansion on any considerable scale.

FANS.—Jobbers are stocking up somewhat, and the opinion is expressed that prices will hold firm for the remainder of the 1919 production season. There are signs of an excellent demand.

WIRE.—Base prices about 2 cents below the figures of week before last are noted. Rubber-covered and weatherproof wire are quoted around a 24-cent base and bare copper wire at 20 cents. The demand is very light.

POLE-LINE MATERIAL.—Stocks are well prepared to meet a rapid expansion of business, but as yet the lid is down pretty tight on central-station developments. Some of this material is about due to move, however, and lower prices on wire may help.

MOTORS.—Stocks are still rather spotty in the larger sizes. The demand is light at present, but prices hold remarkably steady. Distributers are building up more representative stocks every week.

STARTING AND LIGHTING SETS.—All signs point to a big year in automobile production. The pleasure car market is most promising, and while stocks of electrical accessories are at present in fairly good shape, there is some question how long this condition can be maintained. Prices are firm and distributers extremely active preparing for work at the automobile shows, some of which have already opened.

STORAGE BATTERIES.—The outlook for a remarkable year's business is good. Stocks are being gradually built up in the face of a heavy demand from the automobile industry. Government business has fallen off to modest proportions of the total volume. Prices are still pretty firm, but it is likely that reductions will be in evidence before long, though it is any man's guess when the recession will occur. Deliveries are improving as the result of vigorous work by the factories. The need of throwing open the steam railroad market for signal, car-lighting and other batteries is emphasized among the trade.

ELECTRIC LOADING MACHINERY.—Inquiries are improving and a renewal of ordering is beginning to be noted. Prices are not likely to increase, and deliveries from stock can be made readily. Some special machinery is now on order.

WASHING MACHINES.—Jobbers are buying on a fair scale, and the domestic labor situation seems unlikely to improve to a point where this business will be seriously affected, at least for the present.

PORTABLE LAMPS.—A fair turnover continues despite the increasing length of days. The removal of all lighting restrictions has unquestionably been a very helpful psychological factor in stimulating this class of business.

DRY BATTERIES.—Business is quiet and stocks are in reasonably good shape for the most part. It is believed that prices will show some recession before many weeks.

ATLANTA

Some stimulation is noted in building activity this week. Reports state that Mississippi lumber dealers are enjoying so great a business that many yards have received more orders than they can conveniently fill at present. Repairs and remodeling on a large scale are taking place. Architects of the Southeast are confident that better weather in the spring will bring a large amount of construction work. Reports from various Southern states show that the supply of labor in general is about equal to the demand. Labor conditions at Atlanta are somewhat unsettled because of the declaration by the Builders' Trade Association for an open shop in order that returning soldiers may not be deprived of an opportunity to secure work.

A tentative agreement between the electrical contractors and electrical workers was reached this week, whereby the men will go back to work pending a settlement on the open-shop proposal, which has been put in the hands of Mayor Key for mediation. Presaging building construction, real estate appears to be becoming more active.

The War Department has not definitely decided to discontinue all work at Camp Benning, Columbus, Ga. The Georgia-Alabama Power Company, Albany, Ga., recently organized, will take over the Albany Power & Manufacturing Company and the Columbia Power Company, Columbia, Ala., and construct combined hydroelectric and steam plants on the Flint River, Ga., for the development of approximately 15,000 kw.

Manufacturers report business from small central stations and municipalities as being excellent for meters, transformers and general supplies.

MOTORS.—Inquiries seem to be increasing, and business shows considerable improvement over last week. Shipment promises are much shorter and local stocks are accumlating. One manufacturer has reduced prices about

10 per cent, claiming increased factory efficiency as the result. Inquiries among other motor representatives, however, failed to produce any concrete evidence of a general cut in motor prices.

LIGHTNING ARRESTERS.—Prices remain firm, but buying has dropped off unexpectedly.

GENERATORS.—Activity is increasing in the small alternating-current sizes, and orders booked show a decided improvement. A slight decrease in price generally was recorded this week. Factory shipments are getting much better.

TRANSFORMERS.—The demand for the large-power type is dull and comparatively little business is being done. It is rumored that a 10 per cent reduction in price is coming very soon.

METERS.—The small central stations continue their steady buying of the residential type. No change in price is noted and deliveries are excellent.

FEEDER AND GENERATOR VOLTAGE REGULATORS.—Manufacturers state that inquiries are growing, with a corresponding increase in the volume of sales compared with the earlier weeks of February. The recent drop of 5 per cent in price has no doubt tended to stimulate sales. Shipment promises are more encouraging.

CHICAGO

Only 3000 buildings were erected in Chicago during 1918, as against 10,000 buildings of about the same average value in 1916. The Chicago Association of Commerce and other civic organizations realize the necessity of a widespread inauguration of building activities and are using their influence to get new buildings started without further delay.

Work was started this week on the new Union Depot. Morris Gest, a New York theatrical manager, announced that he will build a new theater in the "loop." John S., Henry C. and Howard Phipps of New York have agreed to build a burlap-bag factory to cost $175,000 in the Kenwood manufacturing district for Marshall Field & Company. The suburb of Winnetka plans to place all lighting and telephone wires underground and to make a number of other public improvements.

The agricultural districts of the Middle West and South are expected to be productive of good business. The agricultural sections will be less severely hurt by taxation than industrial sections. The farmer is only subject to the taxes of an individual.

WIRE.—The base on both rubber-covered and weatherproof wire is down to 23 cents. Bare wire has a spread of from 19 to 22 cents, but there is little call for it.

CONDUIT.—Conduit remains firm.

IRONING MACHINES.—There is a shortage in jobbers' stocks.

DISHWASHERS.—Some manufacturers have been unable to keep up with their orders.

SEATTLE—PORTLAND

Contrary to expectations, strikers in Seattle and Tacoma did not return to work on Feb. 19. In fact, shipyards and shops did not attempt to open gates. This change of program on the part of shipyard owners came as a complete surprise and was probably because employers concluded that sufficient men would not return to justify the endeavor. Up to date the strike is as far from or further from settlement than it has been at any time since it began. The Pacific Coast district metal trades conference, which concluded a week's session in Portland on Feb. 22, was apparently fruitless of result as regards early settlement of difficulties.

The strike is having an exceedingly detrimental effect on all lines of business. Electrical jobbers report that sales, aside from those to shipyards and industrial plants, are fairly satisfactory. However, the major portion of jobbers' business is with shipyards Dealers report a marked decrease in sales of fixtures and domestic appliances. There is no further change in prices, and the likelihood of early decreases is considered as purely a matter of personal opinion. The larger jobbers believe that lowering of wages is absolutely essential before prices drop. Stocks are in excellent shape owing to the improvement in the freight situation, cessation of hostilities and the government's being out of the market. Smaller concerns which are unable to shift stocks to branch houses and which since the strike have no outlet for merchandise are in many cases overstocked along some lines.

The Portland district reports the industrial situation somewhat improved. The recent action of the Emergency Fleet Corporation in reinstatement of six steel vessel contracts at three large Portland yards previously put on the suspended list has caused a material improvement temporarily. Award of contract for the Astoria Flouring Mills is followed by information that the industry will be entirely motor-driven, utilizing 1000 hp. The mills will be the largest in Oregon. The construction of a five-mile transmission line for supplying three-phase, 2200-volt power to farmers in the McMinnville (Ore.) district is reported. Small sales of electrical supplies continue good. There are, however, no particularly large sales to report nor no particular movement of any one line of merchandise. The spruce production division has opened sale bids on approximately 200 motors ranging from 5 hp. to 75 hp. The bids ranged from 30 to 40 per cent of cost to government new and were appreciably below what had been hoped for.

SAN FRANCISCO

Rains have been plentiful. Farmers and fruit men are everywhere jubilant over the prospects for 1919. Further, live stock is in good condition and feed plentiful. The heavy late snows on the Sierras will fill the reservoirs of the hydroelectric systems. The Pacific Coast is getting good shipments from the factories. The breakdown of the Seattle strike has given a salutary lesson to California labor radicals. The recent Oakland strike in defiance of the national unions was broken by most of the strikers themselves returning to work. The labor situation at San Francisco and Los Angeles is quiet.

POLE-LINE HARDWARE.—New state and power line construction is being planned by three companies—the San Joaquin Light & Power Corporation, in the vicinity of Chowchilla; the Sierra & San Francisco Power Company, in the district north of Modesto, and the Western States Gas & Electric Company for the city railroad system in Eureka. Prices on lag screws, carriage bolts, double-arm bolts, etc., have decreased about 10 per cent and crossarm braces about 15 per cent. Hopes are expressed that there will be a lot of necessary construction this season, especially for isolated farms that are not on the main distribution lines.

WIRING DEVICES.—There is a steady call for schedule material such as sockets, switches, etc., but in hand-to-mouth quantities. As a result of a recent debate at one of the San Francisco organizations, the local underwriters intend to investigate the reported misuse of two-way and three-way plugs inserted in one socket. A certain faction wishes to discontinue their use.

WIRE.—For the third time this year rubber-covered wire has dropped, although No. 14 single-braid solid is still constant at about $14.25 per 1000 ft. in carload lots. Other sizes have dropped about 5 per cent, except the heavy circular-mil sizes, which have decreased 15 per cent. Asbestos-covered magnet wire base is quoted at $0.54 per pound, a drop of about 5 per cent. Telephone wires have dropped nearly 25 per cent, and office annunciator wires at one bound decreased 15 cents per pound. Plenty of rubber-covered wire is being sold, and local stocks are good.

CONDUIT.—Certain sizes show a very small decrease, but more as the result of new methods of figuring than as the result of price change, the drop being more noticeable on the smaller quantities. Local stocks are better than they have been for many months.

Current Prices of Electrical Supplies

New York and Chicago Quotations

THE prices quoted are those prevailing in standard packages of specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists of contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the sources of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers. Price variations may be due to difference in grade of products of different manufacturers, to local conditions, or to both.

ARMORED CONDUCTOR, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE AND DISCOUNT PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

Twin-Conductor

No. 14 Solid	
Less than coil	List
Coil to 1000 ft	10%
No. 12 Solid	
Less than coil	List
Coil to 1000 ft	10%

DISCOUNT—CHICAGO

Single-Conductor

No. 14 Solid	
Less than coil	+20%
Coil to 1000 ft	List
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

Twin-Conductor

No. 14 Solid	
Less than coil	$115.00
Coil to 1000 ft	100.00
No. 12 Solid	
Less than coil	+20%
Coil to 1000 ft	List

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each.
Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	+20%
1/5 to std. pkg	List
Std. pkg	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	+30% to List
1/5 to std. pkg	+5% to 20%
Std. pkg	18% to 36%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45—$0.46	$0.45—$0.47
12 to 50	.40	.40— .41
50 to barrel	.35— .36	.36— .37
Barrel lots	.32— .329	.33— .339

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.45	$0.45
12 to 50	.38	.38 to $0.39
50 to barrel	.35 to $0.362	.35 to .372
Barrel lots	.326 to .332	.326 to .342

CONDUIT, METALLIC FLEXIBLE

Size, In.	Ft. per Coil	List per 100 Ft.
3/8	250	$5.00
1/2	250	7.50
3/4	100	10.00
1	50	13.00
1	50	21.00
1 1/4	50	26.00
1 1/2	25–50	35.00
2	25–50	45.00
2 1/2	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
3/8-in. single trip	$75.00	$63.75— 69.75
3/8-in. double strip	75.00— 82.50	72.00— 75.00
1/2-in. single strip	100.00	85.00— 93.00
1/2-in. double strip	100.00—110.00	96.00—100.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
3/8-in. single strip	$75.00	$63.25 to $63.75
3/8-in. double strip	78.25 to $78.75	71.25
1/2-in. single strip	100.00	75.00 to 85.00
1/2-in. double strip	105.00	93.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List per Foot	Size, In.	List per Foot
3/8	$0.05½	1	$0.25
1/2	.06	1 1/4	.33
3/4	.09	1 1/2	.40
3/4	.12	1 1/2	.47
1	.15	2	.55
1	.18	2 1/2	.65

NET PER 1000 FT.—NEW YORK

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$25.00–50.70	$24.00–35.20	$23.00–30.25
1/2-in.—	30.00–56.40	28.00–38.40	26.00–33.00

NET PER 1000 FT.—CHICAGO

	Less than $15 List	$15 to $60 List	$60 to $150 List
3/8-in.—	$60.00	$30.00	$26.00–26.50
1/2-in.—	65.00	32.00–32.50	29.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 40

Size, In.	Conduit, List per Foot
1/4	$0.08½
3/8	.08½
1/2	.08½
3/4	.11½
1	.17
1 1/4	.23
1 1/2	.27½
2	.37½
2 1/2	.58½
3	.76½

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON—Continued

Size, In.	Couplings, List	Elbows, List
1/4	$0.05	$0.19
3/8	.06	.19
1/2	.07	.19
3/4	.10	.25
1	.13	.37
1 1/4	.17	.45
1 1/2	.21	.50
2	.28	1.10
2 1/2	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	1/4 in. to 1/2 in.	3/4 in. to 3 in.
Less than 2500 lb.	7% to 7.1%	9% to 9.1%
2500 to 5000 lb.	10% to 10.1%	12% to 12.1%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	1/4 to 1/2 In.	3/4 to 3 In.
Less than 2500 lb.	+3%	+1% to 2%
2500 to 5000 lb.	+1% to 2%	+4%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

List price	$6.50 to $7.00
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.50
Discount	20% to 30%

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	30%
1/5 to std. pkg	41%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	30%
1/5 to std. pkg	40% to 41%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg	$6.00 to $8.75
1/5 to s[illegible] pkg	5.50 to 7.00

Standard packages, 500. List, each, $0.07

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg	$8.00
1/5 to std. pkg	7.00

Standard packages, 500. List each, $0.07

LAMPS, MAZDA OR TUNGSTEN

110 to 125 Volts

Regular, Clear:	Std. Pkg.	List Each
10 to 40-watt—B	100	$0.35
60-watt—B	100	.40
100-watt—B	24	.85
75-watt—C	50	.70
100-watt—C	24	1.10
200-watt—C	24	2.20
300-watt—C	24	3.25
Round Bulbs, 3½-in., Frosted		
15-watt—G 25	50	.60
25-watt—G 25	50	.60
40-watt—G 25	50	.60
Round Bulbs, 3½-in., Frosted:		
60-watt—G 30	24	.82
Round Bulbs, 4½-in., Frosted:		
100-watt—G 35	24	1.15

DISCOUNT—NEW YORK

Less than std. pkg.	List
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pkg.	List
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.18—$40.77
Coil to 1000 ft	28.60— 32.98

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$32.00—$36.00
Coil to 1000 ft	25.00— 27.00

LAMP GUARDS, WIRE

Standard packages from 50 to 150

NEW YORK

Net per 100	$33.00

CHICAGO

Net per 100	$33.00

OUTLET BOXES

Nos.	List per 100
101—A, A 1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200, S.E., 300, A.X., 1½, 4 S.	30.00
103—C.A., 9, 4R, B 1½	25.00
106—F.A., 7, C.S., 1½, 3 R	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	26%	20%
$10.00 to $50.00 list	36%	31%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	20%–32%	10%–27%
$10.00 to $50.00 list	30%–40%	20%–35%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	5%
1/5 to std. pkg.	15%
Std. pkg.	25%

PORCELAIN CLEATS—UNGLAZED

Two and Three Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg	$20.00 to $21.00
1/5 to std. pkg.	17.00 to 17.85

Standard package, 2200. List per 1000, $21 to $34

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$21.00–$24.15
1/5 to std. pkg.	17.85– 21.00

Standard package, 2200. List per 1000, $20.00

PORCELAIN KNOBS

NEW YORK

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid	Std. Pkg. 4000 Nail-it—N.C.
Less than 1/5 std. pkg.	$16.00	$26.00
1/5 to std. pkg.	13.60	21.20

CHICAGO

Per 1000 Net.	Std. Pkg. 3500. 5½ N.C.—Solid	Std. Pkg. 4000 Nail-it—N.C.
Less than 1/5 std. pkg.	$13.00–$18.40	$32.00–$36.80
1/5 to std. pkg.	11.50– 16.00	27.20– 32.00

SOCKETS AND RECEPTACLES

	Std. Pkg.	List
½-in. cap key and push sockets	500	$0.33
½-in. cap keyless socket	500	.30
½-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg	List

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	List
1/5 std. pkg.	List to 10%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-qmp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	$0.42
60-amp. S. P. S. T.	.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

	High Grade
Less than $10 list	+15% to +10%
$10 to $25 list	+10% to 2%
$25 to $50 list	5%
	Low Grade
Less than $10 list	+5% to list
$10 to $25 list	List to 8%
$25 to $50 list	15%

DISCOUNT—CHICAGO

	High Grade
Less than $10 list	+25%–+15%
$10 to $25 list	+10% to 2%
$25 to $50 list	+5% to 5%
	Low Grade
Less than $10 list	+15% to +5%
$10 to $25 list	2% to 8%
$25 to $50 list	5% to 15%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole, ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp. three-point	100	.54
10-amp. three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

10-Amp., 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

SWITCHES, SNAP AND FLUSH—Continued

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	+20%
1/5 to std. pkg.	List
Std. pkg.	15% to 17%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	+30% to list
1/5 to std. pkg.	+5% to 10%
Std. pkg.	8% to 18%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar—	List Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	Net to 18%	Net
$2.00 to $10.00 list	10% to 28%	5%
$10.00 to $50.00 list	20% to 45%	10%

DISCOUNT—CHICAGO

	Galvanized	Black
Less than $2.00 list	25% to 40%	20% to 30%
$2.00 to $10.00 list	25% to 50%	20% to 40%
$10.00 to $50.00 list	25% to 64%	20% to 52%

TOASTERS, UPRIGHT

NEW YORK

List price	$6.00 to $6.50
Discount	20% to 25%

CHICAGO

List price	$6.35 to $7.00
Discount	20% to 30%

WIRE, ANNUNCIATOR

NEW YORK

	Per Lb. Net
No. 18, less than full spools	$0.46–$0.66
No. 18, full spools	.44– .56

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.60 to $0.90
No. 18, full spools	.53 to .64

WIRE, RUBBER-COVERED, N. C

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00–$25.09	$11.00–$17.00	$11.00–$15.00
12	21.40– 27.09	19.26– 23.22	16.05– 23.22
10	28.94– 32.40	26.06– 32.40	20.83– 27.45
8	35.82– 45.72	32.84– 45.72	28.66– 38.10
6	56.70– 72.36	51.98– 60.30	45.36– 57.88

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 2500 Ft.	2500 to 5000 Ft.
14	$19.50–$20.00	$14.50–$15.00	$13.00–$14.50
12	17.50– 24.57	17.55– 24.57	17.55– 21.06
10	24.05– 32.97	24.05– 32.97	21.16– 28.26
8	33.35– 46.69	33.35– 46.69	29.35– 40.02
6	52.95– 73.71	46.60– 63.18	46.60– 52.65

WIRE, WEATHERPROOF

Solid-Conductor, Triple-Braid, Size 4/0 to 3 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb	$29.75 to $34.75
25 to 50 lb	29.75 to 34.75
50 to 100 lb	28.75 to 33.75

CHICAGO

	Per 100 Lb. Net
Less than 25 lb	$32.75 to $35.75
25 to 50 lb	31.75 to 34.75
50 to 100 lb	30.75 to 37.35

NEW APPARATUS & APPLIANCES

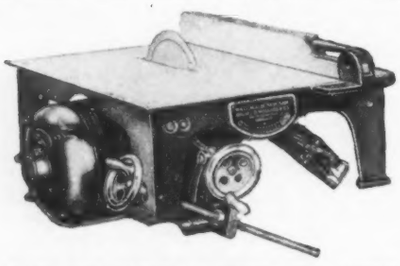
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Portable Bench Wood Saw

The time usually wasted in walking to and from stationary sawing machines may be saved through using the portable bench saw recently developed by J. D. Wallace & Company, 1401 West Jackson Boulevard, Chicago. While designed to operate from an ordinary incandescent socket, it is said to have ample power to cut through the hardest wood, making its use possible for a majority of the work customarily done by hand or on large saws in pattern, cabinet, jobbing and contracting carpenter shops or in woodworking plants.

A number of useful features are pointed out, among these being that in order to cut at an angle the saw is tilted instead of the table. This, it is claimed, makes it possible to cut long stock without fear of breaking it by coming in contact with the floor as sometimes happens when tilting tables are employed. Other advantages accruing from the tilting-saw design are that the operator always works at a table in a horizontal position and the exact angle at which the wood is to be cut may be set by spinning a hand wheel until the desired angle is registered on a dial. This tilting mechanism swings a cradle containing the saw, the driving mechanism and a ½-hp. General Electric motor. The motor is equipped with a ball bearing that acts as a thrust bearing when the motor is tilted for angle cutting. The saw can be raised and lowered to cut or groove stock any depth up to 2 in. (5 cm.), the mechanism for this operation being controlled by another conveniently located hand wheel.

The cross-cut fence is built into the machine and therefore, while it may



SAW, NOT TABLE, IS TILTED FOR ANGLE CUTTING

be turned under the table when not needed, is yet never off the machine or misplaced. A box-type rip fence is clamped to both sides of the table and is finished on both sides so that it can be used on either side of the saw. A factor in the safe operation of the saw is the shuttle saw guard which is built into the machine and constantly acts as a shield. As the saw goes through the stock this guard slips back and so does not interfere with the saw's efficient operation. Not only does this guard protect the operator's hands, but, the maker points out, it also prevents two other causes for accidents — the catching of the tail end of the stock in the back of the saw and the catching of the waste stock in the saw's teeth.

Outdoor-Service Electric Foot Warmer

Among the applications to which the outdoor-service foot warmers being made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., may be put are warming the feet of watchmen at industrial plants and those of motormen and conductors on railway cars. Three heats for moderately cold, cold and extremely cold weather are provided, in this way obviating the possibility of harm resulting from the feet becoming too warm. The casing of the heater is

UPPER SIDE OF WATERPROOF HEATER

made in one piece of either cast iron or copper and is 20 in. (51 cm.) long, 14 in. (36 cm.) wide and 2½ in. (6 cm.) high. To prevent the foot from slipping, the top surface is diamond treaded and to raise it 1 in. (2.5 cm.) above the ground supports are provided at the corners of the under side. The heating unit is clamped against the under side of the main casting by a sheet-steel clamping plate and is made waterproof by means of a bottom sheet-steel plate sealed with waterproof gum. The slotted ribbon-type resistance is distributed uniformly over the entire surface, the ribbons being assembled between two thin plates of built-up mica cemented together to form a unit. By means of the three-heat control snap switch 200 watts are obtained when two equal circuits of 100 watts each are connected in parallel; 100 watts are produced on medium by using one circuit only, and 50 watts may be obtained by connecting the two circuits in series. The rubber-insulated triple conductor enters the warmer through a bell-mouth waterproof fitting mounted in the middle of one 14-in. (36-cm.) edge.

Chandelier Pull Switch

What is known as the "In-B-Tween" chandelier pull switch has recently been placed on the market by the Peerless

STYLE THAT IS USED WITH THREE-CHAIN FIXTURE

Light Company, Halsted, Adams and Green Streets, Chicago. It is said to eliminate the necessity of a side-wall switch and to form a neat appearance. The stem of the new switch, which may be obtained either with or without a canopy, is 6 in. (15 cm.) long. Cast armor covers the mechanism, and the switch, ornamental in appearance and having a finish of brushed brass, may be applied to single or three-chain lighting fixtures. The bottom part of the armor has a large square pin that engages a bayonet slot in the upper portion of the armor so that by a quarter turn it will lock into place and will not work loose. The manufacturer claims that the device has sufficient strength and capacity to support and control any lighting fixture or commercial unit with a mogul lamp base.

Forced-Draft Chain-Grate Stoker

A traveling grate stoker which can be readily converted to use either natural or forced draft has been developed by the James A. Brady Foundry Company of Chicago. It consists of cast-iron side frames carrying the driving gear, hopper front, shaft and feed gate in the usual manner. The side girders are formed of structural steel members built like a truss, permitting stokers 20 ft. (6 m.) in length to be built.

Transverse members of structural steel support a series of tracks on which semi-steel chains operate. These tracks carry and support the grate surface, take up the stress and tension of the chain, and are provided with V-rollers to insure alignment both horizontally and vertically and to reduce the power required for driving the stoker. Attached to the chains is a series of transverse racks or beams on which the clips or grate bars forming the grate surface are attached. These grate bars are sufficiently loose to slide over the ends of the racks readily. This is said to prevent any rusting together of adjacent parts. Each row is held in place by a single cotter pin, and any one bar can be readily replaced without stopping the stoker. The straight under-surface of these racks makes possible a practically air-tight diaphragm or seal between the adjacent draft compartments.

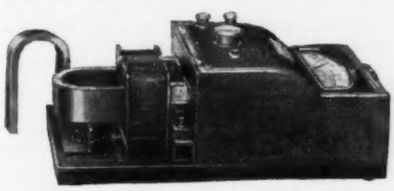
A simple form of adjustable damper controls the air pressure in each respective compartment, so that the proper draft can be maintained under each section of the stoker. Each communicating passage through the side wall terminates in a removable door, which, when taken off, allows free access to the chambers. The closing of the damper and the removal of this door puts the stoker on a natural-draft basis.

The non-sifting grate surface is considered by the manufacturers to be one of the novel features of the stoker. The grate bars fit so closely together that in passing through an arrangement of air passages the air makes two right-angle turns and the lower shoulder at the joint prevents the flow of fuel through the grate. Projections hold the adjacent surfaces apart so that an air space of approximately 15 per cent is assured.

Joseph A. Harrington, designer of the stoker, considers it feasible to develop combustion rates exceeding 75 lb. of coal per square foot (756 kg. per sq.cm.) of grate area per hour from these stokers.

Magnet-Testing Instrument

To facilitate the inspection and testing of shaped or horseshoe permanent magnets by comparative measurements



SHOWING COMPACTNESS AND POSITION OF INSERTED MAGNET

of flux which determine their initial strength and their stability or coercive force—that is, their power to retain the flux under use—Herman A. Holz, of 1 Madison Avenue, New York City, is marketing the illustrated magnet-meter. This device is also said to be well adapted for determining by means of flux tests carried out at intervals whether magnets are properly aged, such tests being particularly desirable where magnets are in use in electrical measuring instruments.

In this instrument a coil capable of rotary movement, to which is attached a pointer traversing a calibrated scale, is supported between two iron pole pieces. This movable system and scale are inclosed in an air-tight housing. The pole pieces are extended through the housing into contact faces or plates, to which the polar portions of the magnet under test are applied. When a definite current is allowed to flow in the moving coil a deflection of the pointer occurs which is proportional to the flux in the magnet applied to the contact faces.

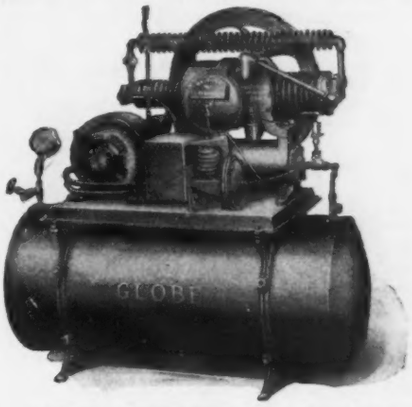
In measuring the magnetic stability of the magnet two adjustable solenoids are employed, being placed in front of the contact faces so as to encircle the respective legs of the test magnet. If current is allowed to flow in the proper direction through the windings of these solenoids when the pointer is deflected in reading the flux, such deflection may be reduced to zero by regulation of the current. The value of this current indicates directly the stability of the magnet.

It is pointed out that the measurement of flux does not affect the magnetization and the state of the magnet remains unchanged. The measurement of stability involves a demagnetizing operation, and the magnet must be remagnetized after such a test. Therefore the flux test may be carried out on each magnet, while it may be found advisable, except in special cases or in investigation work, to test for stability only a few magnets selected as samples from the lot.

Contact shoes are provided to permit of ample contact between the polar portions of the test magnet and the contact plates in cases where the ends of the magnet are not finished. No bushings of any kind are required to adjust the instrument for testing different sizes of magnets. The complete equipment includes the magnet-meter, a milliammeter, an ammeter, three rheostats and two switches.

Motor-Driven Air Compressor Equipment

For garages, vulcanizing shops and other places requiring compressed air at all times the Globe Manufacturing Company of Battle Creek, Mich., has recently developed the "Victory" model two-stage air compressor driven by an electric motor and equipped with an air storage tank. The compressor used is of two-stage construction and is said to be very efficient and economical. It has a capacity sufficient for the average garage, tire shop or free-air station and a maximum pressure of 300 lb. (21 kg. per sq.cm.). The 30-gal. (113-l.) horizontal cylindrical steel tank upon which the machinery is mounted has a guaranteed working pressure of 150 lb. (11 kg. per sq.cm.). Motors of ½ hp. to 1 hp. are supplied for use on all kinds of circuits. Because the outfit is equipped with an automatic pressure unloader, protection is afforded



CAN BE CONVERTED INTO A PORTABLE OUTFIT

against motor troubles and the blowing of fuses. When starting the outfit there is no compression until the normal working speed of the motor is reached, at which time the release valve is opened. The fittings of the new unit include a pressure gage with a needle valve, 25 ft. (7.6 m.) of air hose with an air chuck, and a brass taper connection with an air needle attached. The height of the outfit is 38 in. (0.96 m.); it occupies a floor space 19 in. by 40 in. (0.79 m. by 1.02 m.) and has shipping weight of 475 lb. (215.4 kg.).

NOTES ON RECENT APPLIANCES

Demagnetizer

To make possible the use of magnetic chucks for grinding and similar operations without the disadvantage of having the work magnetized, the William F. Davis Machine Tool Company, 149 Broadway, New York City, is manufacturing a device which will demagnetize small metal pieces passed through it.

Steel Etching Device

An outfit for etching numbers or names on machine parts, steel tools and other similar objects is being manufactured by the Gibb Instrument Company of Detroit, Mich., and is known as the "electrograph." The apparatus can be used with either 110 volts or 220 volts, 60 cycles, alternating current.

Portable Lamps

An adjustable portable electric lamp constructed of metal with mahogany, brushed brass and etched finishes and for use as a stand or wall lamp or clamped to chair backs and beds has been placed on the market by the Faries Manufacturing Company of Decatur, Ill.

Trade Notes

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm of manufacturers in Switzerland (No. 28,407) wishes to purchase electrical outfits, lighting and starting equipments for motor cars, and particularly a combined dynamo and starter for four-cylinder engine, 80 in. by 130 in. and 90 in. by 150 in. Terms, cash. Correspondence may be in English.

Literature regarding the third Bordeaux fair, which is to be held from May 31 to June 15, has been received by the Bureau of Foreign and Domestic Commerce in the form of (a) application blanks for participation in the fair; (b) sample contracts for advertising space in the official catalog, and (c) pamphlets describing the plan of the buildings and their location on the Place des Quinconcs, presenting the advantages from buyers and sellers meeting at this point and giving information in regard to the date of subscriptions, accommodations offered in the way of customs, furnishings, lodgings, etc. John M. Chapman, president of the Lamontagne, Chapman Company, Inc., 101 Park Avenue, New York, is the official representative of the fair in this country, and those desiring further information are advised to get in touch with him. Copies of the literature referred to may be obtained from the Bureau of Foreign and Domestic Commerce or its district or coöperative offices by referring to file No. 110,760a.

A company in Italy (No. 28,368) desires to purchase 50,000-volt insulators; transformers of from 1000 kw. to 3000 kw. and higher, with the following capacities; 55,000/10,000 volts and 55,000/2000 volts, frequency 42 cycles; cabin insulators, 55,000 volts; copper cables, seven wires, 65 mm. E; copper ropes, seven wires, 52 mm. E, and wire, diameter 60/10, 45/10, and 38/10. Quotations should be f.o.b. New York. Payment through bank in New York.

A man in Belgium (No. 28,388) desires to secure an agency for the sale of electrical supplies. Correspondence may be in English.

THE PULVERIZED FUEL EQUIPMENT CORPORATION has recently been organized for the purpose of taking over the business of the Locomotive Pulverized Fuel Company and to broaden the activities of the latter to cover the central power station, metallurgical and industrial fields. The head offices are at 30 Church Street, New York City, with a Canadian office in the Transportation Building, Montreal. The officers of the new company will be J. S. Coffin, chairman; J. E. Muhlfeld, president; H. F. Ball, vice-president, executive; H. D. Savage, vice-president, in charge of sales; V. Z. Caracristi, vice-president, in charge of engineering, and Samuel G. Allen, secretary-treasurer.

THE AMERICAN APPLIANCE COMPANY, INC., lamp and specialty manufacturer and distributer, announces that it has recently opened an additional branch at 318 West Washington Street, Chicago, in charge of Roy L. Schaulin, who was formerly the Franklin Electric Manufacturing Company's representative in charge of the New York office, and before that associated with the ELECTRICAL WORLD. The company has also opened up a Cleveland branch at 419 Prospect Building in charge of E. L. Wohlfeld, who was formerly in charge of the Evansville branch. This gives the company branches at Indianapolis, New York, Chicago, Atlanta, Detroit and Cleveland, and it is contemplating opening up one additional branch within the next thirty days and probably two more before the end of the year. The Western Agencies Company, at 285 Minna Street, San Francisco, has been appointed as the company's representative for the State of California. N. Abrams, the proprietor of the Western Agencies Company, was formerly connected with the United States Incandescent Lamp Company in St. Louis as its San Francisco representative, previously to which he was associated with the Interstate Electric Novelty Company on the coast.

PAUL J. WILLIAMS, formerly with the Electric Appliance Company, has severed his connection with that company and established an illuminating engineering office at 1188 Oak Street, Columbus, Ohio.

WILLIAM H. FERNHOLZ, Mack Building, Milwaukee, Wis., has been appointed the exclusive representative in the Wisconsin territory for the Electrical Engineers' Equipment Company, 710 West Madison Street, Chicago.

THE BADENHAUSEN COMPANY, boiler and engine manufacturer, announces the opening of a Pittsburgh office at 5030 Jenkins Arcade, in charge of A. D. Neeld, Jr. This office will control the sales in the Ohio, West Virginia and western Pennsylvania territory.

THE UNDERFEED STOKER COMPANY of America has moved its general offices from Chicago to the Book Building in Detroit. This will not interfere with the sales work of the Chicago district sales offices in the Harris Trust Building, nor any of the other district offices.

B. J. ALPIN, for a number of years with the New York Edison Company and more recently general agent of the Yonkers (N. Y.) Electric Light & Power Company, has opened an office at 30 Church Street, New York City, as representative of the Chelten Electric Company, manufacturer of switches and cut-outs.

THE BLACK & DECKER MANUFACTURING COMPANY of Baltimore, Md., announces that R. G. Ames has joined the organization as branch manager in charge of the Chicago office. Mr. Ames was well known in the automobile accessories trade and for the past ten years has been associated with the Edward A. Cassidy Company of New York.

R. L. M. STANDARD REFLECTORS.—Arrangements have been made with the following manufacturers to fabricate the R. L. M. standard reflector: Adams-Bagnall Electric Company, Cleveland, Ohio; Benjamin Electric Manufacturing Company, Chicago; Central Electric Company, Chicago; George Cutter Company, South Bend, Ind.; Harvey Hubbell, Inc., Bridgeport, Conn.; Ivanhoe-Regent Works, Cleveland, Ohio; Wheeler Reflector Company, Boston, Mass.

THE ST. PAUL ELECTRIC COMPANY, electric supply jobber of St. Paul, Minn., begins with the February issue the distribution of its *Monthly Service Bulletin*. The most important feature of the bulletin is the space devoted to current net prices of electrical goods. It is particularly stated, however, that should prices decline the customer will be charged only prevailing price, irrespective of the price quoted in the bulletin. The bulletin also, the company states, will include in each issue articles of an instructive nature. The bulletin is published for the customers of the company solely.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces the appointment of Frank R. Ryan to the sales force of its Chicago office at 740 Monadnock Block. Mr. Ryan graduated from the electrical engineering course of Notre Dame University, spent over a year in the testing department of the Commonwealth Edison Company, about the same time in the testing and operating department of the Sanitary District of Chicago, and was subsequently connected with the Krehbiel Company, consulting engineers of Chicago. For the past six months he has been in the Signal Corps. Mr. Ryan takes the position which was held by Charles H. Nicholson before the latter entered the service and subsequently took charge of the company's Detroit office.

R. E. S. GEARE HEADS NEW COMPANY.—R. E. S. Geare has been elected president of the Mid-West Manufacturing Company, recently incorporated. Mr. Geare is well known to the construction and power-plant field in Chicago and the Middle West because of his active representation of the T. L. Smith Company, Manistee Iron Works Company, Geare & Company and others, which work he will still continue. The Mid-West Manufacturing Company has located its factory in Chicago, with general offices in the Old Colony Building. It has acquired the sales and manufacturing rights of the "Continental" chain-grate stoker from the Manistee Iron Works and of the "Chaingrip" pipe vise and tools from the Gerolo Manufacturing Company. In addition to this the manufacture of special machines, tools and dies, rebuilding of construction and power plant machinery, together with the installation of such machinery, will constitute an important part of the new company's activity.

Trade Publications

REFLECTOR GUARDS.—Bulletin No. 16-6 from Harvey Hubbell, Inc., of Bridgeport, Conn., has for its topic "Locking Guards for Reflectors."

PLUG.—A large folder telling about the Benjamin "two-way" plug is being distributed by the Benjamin Electric Manufacturing Company, Chicago. The folder can be used as a window poster.

METERS.—The "magnet-meter," an apparatus for investigating the magnetic qualities of permanent magnets, is described in a leaflet issued by Herman A. Haltz, Metropolitan Tower, New York City.

COPPER.—A leaflet called "Copper History," which gives the monthly average prices of copper from 1887 to 1918, has been compiled by the Rome Wire Company of Rome, N. Y. Copies may be obtained from this company upon request.

ELECTRIC VEHICLES.—A sixteen-page booklet called "Increasing Income by Reducing Delivery Expense" and two folders descriptive of the "Ward Special" electric vehicle for commercial use have been prepared by the Ward Motor Vehicle Company of Mount Vernon, N. Y.

WELDING.—An interesting booklet entitled "Repair of the German Ships" has been prepared by the Wilson Welder & Metals Company of 2 Rector Street, New York City, and tells of how the damaged interned German vessels were put back into service through the use of plastic-arc welding.

INDUSTRIAL TRUCKS.—"Flat-Wheel Haulage Systems," bulletin No. 25, just issued by the Lakewood Engineering Company, Cleveland, Ohio, shows the Lakewood line of storage-battery tractors and trucks for all kinds of industrial haulage. A table is included which gives the types of trailers recommended for different classes of work.

BELT FASTENING.—The service department of the Crescent Belt Fastener Company, 381 Fourth Avenue, New York City, has just issued a bulletin covering "The Crescent Principle of Belt Joining" which summarizes the reasons why many large industrial plants are standardizing Crescent belt fasteners. This bulletin also contains a ready reference "service chart" by means of which it is claimed that a superintendent, a belt man or a machinist can quickly determine the correct type of belt fastener to use for any condition of work.

New Incorporations

THE BOYLE ELECTRIC COMPANY of Gettysburg, S. D., has been chartered with a capital stock of $100,000 by Frank H. Boyle and others.

THE NOVA (OHIO) ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $5,000 by W. M. Thiedman and others.

THE IRON & STEEL EQUIPMENT COMPANY of Philadelphia, Pa., has been incorporated by J. Vernon Pimm and F. R. Hansell of Philadelphia. The company is capitalized at $50,000 and proposes to manufacture electrical devices of various kinds.

THE REID ELECTRIC & SUPPLY COMPANY of Elkhart, Ind., has been incorporated by Brice H. Reid, L. P. Reid and A. F. Warren. The company is capitalized at $10,000 and proposes to engage in electrical contracting and supply work.

EARLE & PARCELLS, 299 Central Avenue, Newark, N. J., has filed articles of incorporation with a capital stock of $25,000 and proposes to deal in electrical appliances, etc. The incorporators are M. P. and F. H. Earle of East Orange, and W. W. and A. J. Parcells of Newark.

THE CENTRAL NEW JERSEY POWER COMPANY of Morristown, N. J., has been incorporated by John W. Melick and Arthur S. Pierson of Morristown, and Edward Wegman of Yonkers, N. Y. The company is capitalized at $15,000 and proposes to construct and operate an electric power plant with distributing system in Morristown.

New England States

EASTHAMPTON, MASS.—The Hampton Company is contemplating improvements to its power plant, including raising boilers, the installation of stoker and coal-handling equipment.

BOSTON, MASS.—Three petitions have been presented to the Gas and Electric Light Commissioners by the Edison Electric Illuminating of Boston asking for authority to erect an electric transmission line from Boston to Southboro, through Dedham, Dover, Natick, Sherborn, Ashland and Framingham. The first petition asks the commission to determine the line is necessary, the second for authority to take lands and rights-of-way, and the third is for permission to erect the line and for approval of voltage. The voltage will be 25,000 between Forest Hills and the Dedham substation and 69,000 from a substation to be erected at Baker Street and to connect at Sudbury dam with the New England Power Company.

HOLYOKE, MASS.—John J. Kirkpatrick, manager of the municipal gas and electric light plant, has petitioned the Board of Aldermen for an appropriation of $200,000 for extensions and improvements, including the purchase of new machinery for both the gas and electric plants. One-half of the amount asked for is to be used for the electric plant and the other portion for the gas plant.

MILFORD, MASS.—The Milford Pink Granite Company is considering rebuilding its local plant, destroyed by fire on Jan. 31. The buildings destroyed include the main cutting plant, machine shop, forge shop and electric power plant, with equipment consisting of electrically operated traveling cranes, air compressors, etc.

MILLIS, MASS. — Contract has been awarded by the Clicquot Club Company, manufacturers of Clicquot ginger ale, to the Aberthaw Construction Company of Boston for the construction of an extension to its plant at Millis, to include a new bottling building, power house, the removal and re-erection of a storage building. The cost of the work is estimated at about $150,000.

SPRINGFIELD, MASS.—The Turners Falls (Mass.) Power & Electric Company has acquired from the Agawam (Mass.) Electric Company large tracts of land in West Springfield and Agawam, to be used in connection with its electric transmission lines.

STOCKBRIDGE, MASS. — The Lenox Electric Company and the Stockbridge Lighting Company have been consolidated under the name of the South Berkshire Power & Electric Company.

WORCESTER, MASS.—The Board of Gas and Electric Light Commissioners has granted the Worcester Electric Light Company permission to issue $400,000 in capital stock, the proceeds to be used for an extension to its generating system.

Middle Atlantic States

BROOKLYN, N. Y.—Bids will be received by Lindley M. Garrison, receiver of the New York Municipal Railway Corporation, 85 Clinton Street, Brooklyn, until March 4 for the installation of electrically driven, automatically controlled seepage and emergency pumps, etc., in the pump rooms of the Sixtieth Street and Montague Street tunnels. Plans and further information may be obtained at Room 412, 85 Clinton Street, Brooklyn.

GENESEO, N. Y.—The Board of Trustees has awarded contract to the Livingston-Niagara Power Company of Avon for the installation of two electrically driven pumping units in the power house at Conesus Lake. It is also proposed to erect an electric transmission line from the vicinity of Lakeville to the plant. The company has also been authorized to install two Gould triplex pumps with induction motors at the pumping station. Energy to operate the pumps will be furnished by the company at $4,764 per year.

HUDSON, N. Y.—Bids will be received by Mrs. Annie Winsor Allen, president of board of managers, New York State Training School for Girls, Hudson, until March 14 for electrical work including the installation of electric fixtures, additional lamps, in cottages 5, 7 and 10, at the New York Training School for Girls at Hudson. Drawings and specifications may be consulted at the above institution, at the New York office of the Department of Architecture, 1715 Tribune Building, and at the Department of Architecture, Capitol, Albany. L. F. Pilcher is state architect.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

NEW YORK, N. Y.—The United Machine Works, 57 West Third Street, New York City, is reported to be in the market for three 300-kw., 250-volt direct-current generators, directly connected to compound condensing engines, three 500-hp. high-pressure water-tube boilers, chain-grate stokers and one steel stack, 84 in. in diameter, 175 ft. high; open feed-water heater, Cochrane type preferred, of approximately 3000 hp. capacity.

SANBORN, N. Y.—Arrangements are being made by the Sanborn-Pekin Power Company for the extension of its transmission line to Pekin, a distance of 2 miles.

SANGERFIELD, N. Y.—Application has been made to the Public Service Commission by the Waterville (N. Y.) Gas & Electric Company for permission to construct and operate an electric light plant in Sangerfield and for approval of franchise granted by the town.

UTICA, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until March 4, for construction of mortuary and laboratory, including heating, plumbing and electric work, at the Utica State Hospital. L. F. Pilcher, Capitol, Albany, is state architect.

WEST HAVERSTRAW, N. Y.—The board of managers of the New State Hospital for the Care of Crippled and Deformed Children has requisitioned an appropriation of $2,000 to provide for the installation of a new electric lighting system for the grounds at the institution.

BORDENTOWN, N. J. — Considerable electrical equipment will be required in connection with the construction of the proposed new building at the Manual Training and Industrial School at Bordentown. Francis H. Bent is state architect.

DOVER, N. J.—The Morristown Cracked Stone Company has requested the New Jersey Power & Light Company to erect a short extension to its plant near Millington.

NEWARK, N. J.—The capital stock of the Public Service Corporation has been increased from $50,000,000. Arrangements will be made by the company for an issuance of a portion of the increase, including $2,500,000 in notes and preferred stock to the amount of $10,000,000, the proceeds to be used in part for extensions and improvements to its electric plants and system.

PEQUANNOCK, N. J.—The Pequannock Township Committee has made arrangements with the Board of Public Works of Pompton Lakes for furnishing electricty from the new power plant now in course of construction at the foot of Pompton Lake for lighting purposes in Pequannock.

BETHLEHEM, PA. — Plans have been prepared for the erection of a power plant, about 50 ft. by 75 ft.; in connection with the proposed new local plant of the Traveler Tire & Rubber Company, 819 Broad Street, Philadelphia. The cost of the entire works is estimated at about $250,000.

McKEE'S ROCKS, PA.—The Pittsburgh Railway Company contemplates building an addition to its local power house and also a new station at Castle Shannon and new tracks at various points.

OIL CITY, PA.—Plans are under consideration by the city for the erection of an addition to the municipal boiler plant, to cost about $45,000. H. B. Weber is engineer.

PHILADELPHIA, PA.—Plans have been prepared for the construction of a three-story brick tower at Thirty-fourth and Pine Streets, and the installation of two electric elevators for the Philadelphia General Hospital.

PHILADELPHIA, PA. — Considerable new electrical equipment will be required in connection with the construction of the refrigerator and ice plant by Jacob Hornung, 2125 West Clearfield Street, contract for which has been awarded to the P. Haibach Contracting Company, Twenty-sixth and Thompson Streets.

PITTSBURGH, PA.—Contract has been awarded by the Hein Company, 34 Isabella Street, for the erection of an addition to its power house to the George Enzian Company, 8022 Madison Avenue, to cost about $25,000.

SCRANTON, PA.—The Delaware & Hudson Company is contemplating the construction of a new coal breaker to replace the building recently destroyed by fire, causing a loss of about $300,000.

YORK HAVEN, PA.—A portion of the power plant of the York Haven Water & Power Company was destroyed by fire on Feb. 12.

NEW CASTLE, DEL.—The City Council is considering a bond issue for $150,000, part of the proceeds to be used for improvements to lighting and water systems.

WILMINGTON, DEL.—The Standard Kid Manufacturing Company, Fourth and Monroe Streets, is contemplating the construction of a new steam-driven power plant unit at its works.

BALTIMORE, MD.—The City Electrical Commission is planning to extend the electric conduit system in the new annex of the city. The first work to be done is in the Highlandtown and Canton districts. Trunk lines will also be built from the old city line on Belair and Harford Roads and Greenmount Avenue, Falls Road to Mount Washington Avenue, Park Heights Avenue from Mount Washington to Park Heights Avenue, Liberty Heights, Edmondson and Wilkena Avenue and Washington Road. The cost is estimated between $150,000 and $300,000. P. G. Ligon is chief engineer.

CLAY, W. VA.—The Clay Utility Company contemplates the construction of an electric transmission system, including the erection of a substation. Charles and Oscar Hall are interested in the company.

NORFOLK, VA.—Plans are being prepared for the erection of a garage for B. Gray Tunsta and W. C. Cobb, to cost about $250,000. The building will have a capacity of 500 automobiles and trucks and will be equipped with electric elevators.

NORFOLK, VA.—Plans are under consideration by the Treasury Department, James A. Wetmore, acting supervising architect, Washington, D. C., for construction of a quarantine station on Craney Island, including the erection and remodeling of group of twenty-one buildings, sterilizing plant, heating plant, telephone and lighting systems, coal dock, water supply, etc. The cost of the buildings is estimated at about $200,000 and the equipment, $100,000. Captain J. J. Cosgrove, constructing quartermaster, 330 Law Building, Norfolk, is in charge.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until March 10 (Specification 3797) for delivering at the various navy yards condensers, aftercoolers and pumps. The cost is estimated at $388,000.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until March 11 at Washington, D. C., Schedule 3745—3000 lb. electric furnace chrome-nickel steel. Puget Sound, Wash., Schedule 3746—two switchboards complete. Brooklyn, N. Y., Schedule 3738—2000 ft. 10,400-circ. mil two-conductor, braided and leaded, common-type wire. Norfolk, Va., Schedule 3738—miscellaneous nickel-chromium, bare resistance wire. Until March 18, various, Schedule 3773—376 doors, dome and glass for seachlights. Puget Sound, Wash., Schedule 3752—90 storage batteries. Brooklyn, N. Y., Schedule 3771—190,000 ft. hard-drawn copper wire; Schedule 3777—30,000 ft. duplex rubber-covered wire.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the various navy yards and naval stations supplies as follows: Until March 18 for delivering at Washington, D. C., under Schedule 3748—fifty-four disconnecting switches, eight oil circuit breakers, twenty constant-current transformers, dry type; 1800 lb. busbar copper, eight potential transformers, dry type; 100 busbar supports and twelve reverse power relays. Until March 25—Schedule 3827—for Brooklyn Navy Yard, three switch sets and mates. Until March 28, f.o.b., Schedule 3832—ten aircraft transmitter test sets. Until March 7 at Norfolk, Va., Schedule 7813½—miscellaneous copper wire and cable. Mare Island, Cal., Schedule 7815½—one motor-generator set; Schedule 7820½—thirty-four storage batteries. Alexandria, Va., Schedule 7817½—two constant-duty motors and two exhausters. Boston, Mass., Schedule 7821½—one 5-ton trolley with one 5-ton auxiliary hoist. For further information address the above bureau.

North Central States

JACKSON, MICH.—The chair factory building at the Michigan State Prison was recently destroyed by fire, causing a loss of about $450.000.

SUNFIELD, MICH.—The Commonwealth Power Company of Jackson has notified the committee appointed to investigate the feasibility of installing an electric lighting system that it will erect a transmission line to Sunfield, providing the residents will purchase sufficient stock of the company to pay for construction of the line. The cost is estimated at about $35,000.

HAMILTON, OHIO—F. J. Sloat, service director, has recommended to the Council the purchase of electric energy from power plants outside of the city. Mayor Smith and several of the Councilmen are said to be in favor of erecting a new plant to meet the increasing demand for electrical service.

LORAIN, OHIO—The United States government has advanced $500,000 for the completion of the new power plant of the Lorain County Power Company on Second Street. The Utilities Construction Company has the contract for the work. The plant when completed will cost about $1,250,000 and will supply electricity in large quantities to the American Shipbuilding Company.

NEW PHILADELPHIA, OHIO.—Owing to the unsatisfactory service furnished by the Ohio Service Company the City Council is considering the installation of a municipal electric light plant.

DAYTON, KY.—Bids will be received by the Board of Councilmen of Dayton, Ky., until March 17 for the sale of franchise, right and privilege of constructing and operating an electric light and power plant to supply the city and inhabitants with electricity for lamps and motors for a period of nineteen years from Sept. 1, 1919. Further information may be obtained upon application to Will C. Martin, city clerk.

FORT WAYNE, IND.—Preparations are being made by the city of Fort Wayne for the construction of a new filtration plant on the St. Joe River, to cost about $500,000. Considerable mechanical and electrical equipment will be required for the proposed plant.

AURORA, ILL.—The Western United Gas & Electric Company has been granted permission by the Public Utilities Commission to issue $155,000 general mortage bonds and $1,500,000 guarantee debenture notes.

BYRON, ILL.—Plans are under consideration to secure electrical service for Byron, following the failure of the Byron Electric Light Company. It was hoped to secure energy from the Rockford (Ill.) Electric Company, but the company decided that it could not afford to erect a transmission line to Byron. Arrangements may be worked out to secure a combined service for Byron, Stillman Valley and Davis Junction. Albert Johnson is Mayor of Byron.

CAIRO, ILL.—Contract, it is reported, has been placed by the Cairo Railway & Light Company with the General Electric Company for a 2000-kw. turbo-generator.

CHAMPAIGN, ILL.—The Caldwell Electric Company has recently purchased a factory building, into which it proposes to move. It is also planning to erect a large warehouse. The company manufactures general electrical supplies.

CHICAGO, ILL.—The Ilg Electric Ventilating Company has purchased a site at Crawford Avenue and George Street, on which it proposes to erect a factory. The cost of the first unit is estimated at $250,000. If conditions are favorable construction work will start this year.

HILLSDALE, ILL.—The Rock River Valley Light & Power Company, which is planning to install an electric power plant here, will supply electrical service in Silvis and other communities as well as in Hillsdale. The company is capitalized at $15,000. Clarence Britzer, Frank Wake and Fred Frels are among the incorporators.

QUINCY, ILL.—The City Council has adopted a resolution to submit to the voters the proposal to establish a municipal electric plant in Quincy at the April election.

ROCKFORD, ILL.—The Public Utilities Commission has granted the Rockford Electric Company permission to issue $164,000 in refunding bonds and $66,000 in capital stock.

WOODSTOCK, ILL.—The proppsal to issue $25,000 light and power bonds will be submitted to the voters.

MINOCQUA, WIS.—An election will soon be held to submit the proposal to purchase electricity to operate the municipal electric lighting system from the Rhinelander (Wis.) Light & Power Company. E. A. Forbes is president of the Rhinelander company.

HIBBING, MINN.—Preliminary plans are being prepared by Holstead & Sullivan, architects, Paladia Building, Duluth, for the construction of a three-story power power plant, 100 ft. by 150 ft. Charles Foster is general superintendent.

GETTYSBURG, S. D.—Arrangements are being made by the Gettysburg Electric Light Company to extend its transmission lines to the towns in this territory, including Onida, Agar, Labanon, Tolstoy, Seneca and Haven. The cost of the main line is estimated at about $25,000.

CHADRON, NEB.—Application has been made to the City Council by the Chadron Electric Company for a franchise to construct and operate an electric light plant in Chadron for a period of 25 years.

HOOPER, NEB.—The local electric plant of the Nebraska Light & Power Company of Norfolk was recently destroyed by fire, causing a loss of about $15,000.

O'NEILL, NEB.—The local electric light and power plant, owned by the McGinness Creamery & Produce Company, has been purchased by the Hanford Produce Company of Sioux City. Improvements are being made to the plant, including the installation of a new engine and generator. The Hanford company is planning to erect a new creamery, power for which will be supplied from the electric plant.

BAXTER SPRINGS, KAN.—Preparations, it is reported, are being made by E. S. McCombs for the installation of a new electric light plant, work on which will begin in the near future.

Southern States

ASHEVILLE, N. C.—The Asheville Power & Light Company is contemplating the installation of additional machinery.

CHARLESTON, S. C.—A special meeting of the stockholders of the Charleston Consolidated Railway, Gas & Electric Company will be held March 19 to vote on an increase in capital stock of $1,500,000, part of the proceeds to be used for proposed extensions and improvements. Work is under way on an addition to the electric power station of the company and the completion of a transmission system to Port Terminal, North Charleston.

SPARTANBURG, S. C.—Contract, it is understood, has been awarded by the City Council for the installation of an ornamental lighting system on Main, South, Liberty, North Church and other streets.

ALBANY, GA.—The property of the Albany Power & Manufacturing Company has been purchased by Foy & Shemwell & Foy Company, capitalists, who will operate the plant in Albany under the name of the Georgia-Alabama Power Company. The latter company already operates two large hydroelectric plants on the branches of the Chattahoochee River, near Columbia, Ala. It is the purpose of the company to connect its plant, making available 50,000 hp. for the three plants, with its steam auxiliary plants. The Georgia-Alabama Power Company contemplates the construction of a large dam and power plant on the Flint River, work on which will begin in the near future. Mr. Shemwell is president of the company, and W. J. Vestal is secretary-treasurer and general manager, both of Lexington, N. C.

BRUNSWICK, GA.—Plans are under consideration by the Mutual Light & Water Company for improvements to its electric plant.

SAVANNAH, GA.—The city of Savannah is contemplating the installation of an electrically-driven pump at well No. 10, and also drilling a well in the southern section of the city, which will be equipped with an electrically-driven pump.

BLOUNTSVILLE, FLA.—The Council is considering calling an election to vote on a bond issue to provide funds for municipal improvements, including an electric light plant and waterworks system. W. P. Fields is city attorney.

TALLAHASSEE, FLA.—The Board of Public Works would like to receive prices on the following equipment: One 200 or 250-kva., two-phase, 60-cycle, 2300-volt generator directly connected to Corliss, or other economical type, engine; one 200-kva., two-phase, 60-cycle, 2300-volt generator, belt driven; both units to be equipped with exciters and switchboard panel, containing main switch, exciter switch, alternating-current and direct-current ammeters and alternating-current voltmeter, synchronous indicator, plug receptacles and all necessary transformers. W. H. Phillips, 54 North Monroe Street, is secretary of board.

CHATTANOOGA, TENN.—The Chattanooga Electro-Metals Company has contracted with the Tennessee Power Company for electricity to operate its plant for the manufacture of ferro-silicon.

MOBILE, ALA.—The entire boiler room of the plant of the Mobile Electric Company was recently destroyed by fire.

MONTGOMERY, ALA.—Improvements and extensions are under consideration by the Montgomery Light & Traction Company. Ray Rushton is receiver.

CLARKSDALE, MISS.—The Crawley Ice Company is contemplating improvements to its ice factory, including the installation of new machinery, to cost about $40,000.

WESTLAKE, LA.—The Lock-Moore Lumber Company, it is reported, would like to receive prices on a 14-in. by 20-in. twin engine, a 35-kw., 125-volt generator, directly connected to engine, one 15-hp. slide valve engine, 48-in. by 96-in. vertical, and a 75-100-hp. marine boiler.

BRISTOW, OKLA.—The Bristow Ice & Light Company is contemplating extensions and improvements to its electric light plant and ice factory, including the installation of new machinery.

COOPER, TEX.—The Cooper Light & Ice Company, recently incorporated with a capital stock of $50,000, proposes to install an electric light plant and ice factory in Cooper. E. Hendricks is interested in the company.

Pacific and Mountain States

PROSSER, WASH.—Plans are being prepared by the Pacific Power & Light Company for practically rebuilding its entire system in Prosser.

PILOT ROCK, ORE.—The city of Pilot Rock has secured a site on which it proposes to erect an electric light plant.

FRESNO, CAL.—The San Joaquin Light & Power Company contemplates the construction of a 15,000-kw. hydroelectric power plant on the San Joaquin River, and also improvements to its transmision line and distribution system. The cost of the work is estimated at about $3,000,000.

SAN DIEGO, CAL.—Plans have been prepared by the Navy Department for the installation of a new floodlighting system at the naval coaling station at La Playa. The system, it is understood, will consist of high-power projectors with wires running to the lamps from the local power plant in submerged concrete conduits.

SAN PEDRO, CAL.—The Southern California Edison Company is contemplating extensions to its service in Los Angeles harbor.

LEWISTON, IDAHO.—Plans have been outlined by F. S. Rice, mining engineer, for a hydroelectric development on the Salmon River, 35 miles from Lewiston. Water rights have been secured by Mr. Rice at Horseshoe Bend in the Salmon River, and also authority from the government to tunnel through the bend and to construct a dam to divert the flow of the river.

FLORENCE, ARIZ.—Bonds to the amount of $20,000 have been voted for improvements to the municipal electric light plant and $60,000 for waterworks system.

CUTBANK, MONT.—Preliminary plans have been completed by Joseph Seal & Son for the installation of an electric light plant in Cutbank. If the franchise is approved by the Council, work will soon begin on the proposed plant.

MILES CITY, MONT.—In the report recently submitted to the City Council by J. J. McGill, superintendent of the municipal electric light plant, an expenditure of about $45,000 for improvements to the electric plant is recommended. New equipment, including an ash-conveyor, two new boilers with stokers or self-feeding apparatus and a 500-kw. generator with turbine engine, is necessary to meet the requirements for additional service.

LAMAR, COL.—The town officials have petitioned the State Public Utilities Commission for permission to establish a municipal electric light plant.

Canada

NIAGARA FALLS, ONT.—Plans have been prepared by the American Cyanamid Company, 511 Fifth Avenue, New York City, for the erection of two additional one-story buildings, 100 ft. by 180 ft. and 50 ft. by 120 ft., at its plant on the Canadian side of Niagara Falls. The cost of the entire plant, it is stated, will amount to approximately $4,500,000.

TORONTO, ONT.—The estimates of the Ontario Hydro-Electric Power Commission, it is expected, will call for $9,000,000, as the Chippewa extension scheme will be carried on, as well as the development at Nepigon, High Falls and other places.

CAP DE LA MADELEINE, QUE.—An extension to its mills, to cost about $375,000, is reported to be under consideration by the St. Maurice Paper Company of Cap de la Madeleine. J. Louthood is manager.

MOOSE JAW, SASK.—The electrical superintendent has recommended to the City Commissioners extensive improvements to the municipal electric light plant, including the installation of a 3000-kw. turbo-generator. This together with proposed line extensions is estimated at $223,370.

MOOSOMIN, SASK.—The installation of an electric light plant, to cost about $50,000, is reported to be under consideration by the town officials.

ALABAMA LIGHT AND TRACTION ASSOCIATION. Secretary-treasurer, J. P. Ross, Birmingham Railway, Light & Power Co.

AMERICAN ASSOCIATION OF ENGINEERS. Secretary, A. H. Krom, 29 South La Salle St., Chicago, Ill.

AMERICAN ELECTRIC RAILWAY ASSOCIATION. Secretary, E. B. Burritt, 8 West Fortieth St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, INC. Secretary, F. A. Molitor, 35 Nassau St., New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, F. L. Hutchinson, 33 West 39th St., New York City. Board of directors meets monthly. Sections and branches in the principal electrical centers throughout the country.

AMERICAN PHYSICAL SOCIETY. Secretary, Prof. A. D. Cole, Ohio State University, Columbus, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS. University of Pennsylvania, Philadelphia, Pa.

ARKANSAS ASSOCIATION OF PUBLIC UTILITY OPERATORS. Secretary, W. J. Tharp, Little Rock, Ark. Annual meeting, Fort Smith, Ark.

ASSOCIATED MANUFACTURERS OF ELECTRICAL SUPPLIES. General secretary, C. E. Dustin, 30 East 42d St., New York City. Annual meeting, New York, March 20.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, H. T. Edgar, Stone & Webster, Boston, Mass.

ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS. Secretary, John F. Kelly, Empire Building, Pittsburgh, Pa.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS. Secretary-treasurer, Joseph A. Andreucetti, Chicago & North Western Railway, Chicago, Ill.

BRITISH COLUMBIA ASSOCIATION OF ELECTRICAL CONTRACTORS AND DEALERS. Secretary-treasurer, Capt. W. J. Conway, 406 Yorkshire Building, Vancouver, B. C.

CANADIAN ELECTRICAL ASSOCIATION, affiliated with N. E. L. A. Secretary-treasurer, W. Volkman, Toronto Power Company, 12 Adelaide St. East, Toronto, Ont.

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ELECTRICAL SUPPLY JOBBERS' ASSOCIATION, PACIFIC COAST DIVISION. Secretary, Albert H. Elliot, 502 Flatiron Building, San Francisco, Cal.

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Printed in the First Issue of Each Month

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NATIONAL ELECTRIC LIGHT ASSOCIATION. Executive secretary, T. C. Martin, 33 West 39th St., New York City. Annual convention, Atlantic City, N. J., May 19.

NATIONAL ELECTRICAL CREDIT ASSOCIATION. Secretary, Frederic P. Vose, 1350 Marquette Building, Chicago, Ill.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary of electrical committee, Ralph Sweetland, 141 Milk St., Boston, Mass.

NEBRASKA SECTION, N. E. L. A. Secretary-treasurer, R. W. McGinnis, O'Neil Light & Creamery Co., O'Neil, Neb.

NEW ENGLAND ELECTRICAL CREDIT ASSOCIATION. Secretary, Alton F. Tupper, 15 State St., Boston, Mass. Annual meeting, Boston, Mass., June.

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OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, Prof. F. E. Sanborn, Ohio State University, Columbus.

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SOUTHWESTERN SOCIETY OF ENGINEERS. Secretary, C. E. Barglebaugh, 703 First National Bank Building, El Paso, Tex.

TORONTO ELECTRICAL CONTRACTORS' ASSOCIATION. Secretary, E. F. W. Salisbury, 615 Yonge St., Toronto, Ont

TRI-STATE WATER AND LIGHT ASSOCIATION. Secretary-treasurer, W. F. Steiglitz, Columbia, S. C. Annual meeting, Greenwood, S. C., April.

VERMONT ELECTRICAL ASSOCIATION. Secretary-treasurer, A. B. Marsden, Rutland, Vt.

WESTERN ASSOCIATION OF ELECTRICAL INSPECTORS. Secretary, W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill.

WESTERN SOCIETY OF ENGINEERS, ELECTRICAL SECTION. Secretary, E. S. Nethercut, 1735 Monadnock Block, Chicago, Ill.

WISCONSIN ELECTRICAL ASSOCIATION. Secretary, J. P. Pulliam, 1408 First National Bank Building, Milwaukee, Wis. Annual meeting, Milwaukee, March 25-27.

Record of Electrical Patents

Notes on United States Patent.

(Issued Dec. 10, 1918)

1,287,304. ELECTRIC STARTER AND GENERATOR; John O. Heinze, Detroit, Mich. App. filed March 22, 1915. Easily connected to engine of motor vehicles.

1,287,322. POWER-TRANSMISSION CONTROL; Edwin E. Huffman, St. Louis, Mo. App. filed May 9, 1916. Electromagnetic transmission of motor vehicles.

(Issued Jan. 7, 1919)

1,290,229. SWIVEL ATTACHMENT PLUG; John J. Kenney, Pittsburgh, Pa. App. filed April 25, 1917. Simplified form of electrical terminals employed.

1,290,241. ART OF PURIFYING FIRE CLAYS; Henry L. Kohler, St. Louis, Mo. App. filed July 31, 1918. For removing such impurities as feldspar, silica, magnetic minerals and the like.

1,290,269. PRODUCTION OF ALUMINA; Ralph H. McKee, Ridgefield Park, N. J. App. filed June 9, 1917. Process is electrolytic, and in preferred embodiment is cyclical in character, the acid solvent being to a large extent regenerated in the course of the operation.

1,290,289. ELECTRIC FLATIRON; William Morgan, Los Angeles, Cal. App. filed Jan. 28, 1918. Has an automatic circuit breaker to prevent overheating of the iron when not in use and so that the circuit may be broken at any time during the operation.

1,290,344. DYNAMO-ELECTRIC MACHINE; William H. Powell, Milwaukee, Wis. App. filed Feb. 27, 1915. Invention has particular relation to the windings of such machines and to supporting and retaining means therefor.

1,290,362. ELECTRIC SWITCH; Joseph H. Rusby, Nutley, N. J. App. filed June 13, 1917. Means provided coacting with a longitudinally slotted hinged lug for universally adjusting the switch relative to a wall.

1,290,366. COMBINATION HORN AND LIGHT; Wayne D. Schaaf, Aurora, Col. App. filed Aug. 10, 1916. The horn proper serves also as part of the lamp, and the reflector serves as part of the horn.

1,290,367. ELECTRIC WELDING MACHINE; Gustave H. Schkommodau, Cincinnati, Ohio. App. filed Feb. 24, 1917. Enables sections of the work to be readily welded in perfect alignment with each other so that the completed article will be free from distortion.

1,290,369. PROCESS OF AND APPARATUS FOR TREATING OIL; Frank M. Seibert and John D. Brady, Houston, Tex. App. filed Jan. 11, 1918. Comprises a method of separating or breaking the permanent emulsions of oil, watery liquid and mineral matter occurring in the crude oil from petroleum wells.

1,290,382. ELECTRICAL CONDENSER; Nugent H. Slaughter, Queens, N. Y. App. filed March 16, 1917. Fine adjustment, to the precise capacity value desired, may be easily obtained.

1,290,394. CORNER IRON FOR PANELBOARD FRAMES; Henry F. Starrett, Chicago, Ill. App. filed Oct. 27, 1916. Different sides of the frame may be adjusted relatively to the panelboard to fit steel cabinets of varying depths.

1,290,438. WIRELESS SIGNALING APPARATUS; Roy A. Weagant, Roselle, N. J. App. filed April 5, 1915. An improvement on the Fleming vacuum valve.

1,290,443. SPEEDOMETER; Augustus W. Wessoleck, New Britain, Conn. App. filed May 9, 1918. Automatically shuts off the power of a motor or internal-combustion engine when the speed reaches a predetermined point.

1,290,449. CIRCUIT INTERRUPTER; Adolph M. Widerberg, Worcester, Mass. App. filed Nov. 17, 1917. Will sound an alarm when motor vehicle or automobile on which it is mounted is being operated or driven away by an unauthorized person.

1,290,471. SIGNAL LANTERN; Alfred A. Ziegler, Boston, Mass. App. filed Nov. 6, 1915. The lamp block, with its associated members, may be assembled as a unit and applied to or removed from the base block.

1,290,472. STARTER FOR ENGINES; Thomas Zimmerman, Niagara Falls, N. Y. App. filed March 4, 1915. Invention relates to devices having normally incomplete or interruptable transmissions.

1,290,487. BATTERY TRAY; Martin Mella, Philadelphia, Pa. App. filed Sept. 21, 1918. Prevents stresses which cause cracking and breakage of storage-battery jars.

1,290,492. ELECTRICAL MEASURING INSTRUMENT; Clarence A. Boddie, Pittsburgh, Pa. App. filed April 23, 1915. Motor meter operates through wide range of load.

1,290,499. ELECTRICAL MEASURING INSTRUMENT; William M. Bradshaw, Wilkinsburg, Pa. App. filed May 25, 1914. Motor meter operates on a wide range of applied voltage.

1,290,500. ELECTRICAL MEASURING INSTRUMENT; William M. Bradshaw, Wilkinsburg, and Clarence A. Boddie, Pittsburgh, Pa. App. filed June 13, 1917. Magnetic circuit of motor meter deflects large part of main magnetic flux through armature at predetermined times.

1,290,504. IGNITION SYSTEM FOR INTERNAL-COMBUSTION ENGINES; William C. Brinton, Jr., Kennett Square, Pa. App. filed April 10, 1917. Insures simultaneous production of sparks of equal intensity.

1,290,540. KNOB INSULATOR; Gustave Glocker, North East, Md. App. filed March 6, 1918. Porcelain cap and knob can be fired at same time.

1,290,584. PROCESS FOR THE PRODUCTION OF REACTIONS IN GASES IN CLOSED SYSTEMS; Jens L. La Cour, Christiania, Norway. App. filed Nov. 17, 1915. Composition of gas passing through reaction compartment maintained constant.

1,290,594. SYSTEM OF MOTOR CONTROL; Niles D. Levin, Columbus, Ohio. App. filed March 8, 1917. For use in operating a motor-propelled vehicle and a mining mechanism attached thereto.

1,290,598. ENGINE-STARTING DEVICE; Paul M. Lincoln, Pittsburgh, Pa. App. filed Feb. 3, 1913. Electric motor used.

1,290,604. ELECTRICAL APPARATUS; Antonio Longoria, Cleveland, Ohio. App. filed July 7, 1918. Designed for therapeutical use, though not limited to this purpose.

1,290,616. AUTOMATIC SWITCHING APPARATUS FOR TELEPHONE-EXCHANGE SYSTEMS; James L. McQuarrie, Montclair, N. J. App. filed March 30, 1917. Compact, efficient and low in cost of production and maintenance.

1,290,621. RECORDING TELEPHONE; John F. Malthaner, Atlanta, Ga. App. filed Aug. 3, 1915. Receives direct dictation and records telephone messages from ordinary receiver.

1,290,623. ELECTRIC TAP; Orlando R. Marsh, Chicago, Ill. App. filed Nov. 23, 1915. Can be installed without altering present devices.

1,290,624. INTERRUPTER FOR IGNITION DYNAMOS; Charles T. Mason, Sumter, S. C. App. filed April 29, 1918. Break primary circuit of high-tension ignition system to produce current in secondary circuit for sparking purposes.

1,290,628. APPARATUS FOR MEDICAL TREATMENT BY ELECTRICITY; Louis Mayor, Chateau de Montagny sur Lutry, Switzerland. App. filed Sept. 15, 1916. Transformer provided with divided secondary windings, one arranged to light small lamp for endoscopic work and other for producing weak current of high voltage.

1,290,644. BURGLAR-ALARM SYSTEM AND APPARATUS THEREFOR; Theodore H. Nelson, Chicago, Ill. App. filed Jan. 29, 1916. Protects outer doorway which must be used for access to the system.

1,290,645. SWITCHING MECHANISM FOR INTERCOMMUNICATING TELEPHONE SYSTEMS; Theodore H. Nelson, Chicago, Ill. App. filed May 7, 1917. Has two directions of motion, one for selecting line to be connected to the talking line and other for connecting these lines.

1,290,653. FUSING MECHANISM; Carl Pfanstiehl, Highland Park, Ill. App. filed July 14, 1917. Produces puppet valves for internal-combustion engines.

1,290,658. CIRCUIT-CONTROLLING APPARATUS; Walter C. Reed, Dalton, Mass. App. filed Nov. 23, 1916. Can operate expression appliances in electrically operated piano-players and pipe organs using perforated music sheets.

1,290,673. SECTIONAL-PIN INSULATOR; Sol S. Sonneborn, Brooklyn, N. Y. App. filed June 27, 1917. Constructed like condenser so that dielectric strength against puncture is approximately proportional to combined minimum thickness of insulating wall.

1,290,691. TELEPHONE LOCK-OUT RELAY; Frank W. Adsit, Chicago, Ill. App. filed July 29, 1916. Armature may be drawn up with one coil and held by weaker coil.

1,290,700. AUXILIARY ALARM SYSTEM; Clarence E. Beach, Binghamton, N. Y. App. filed Sept. 24, 1914. For fire-alarm systems.

1,290,701. CIRCUIT CLOSER FOR AUTOMOBILE SIGNALS; Joseph Berger, Detroit, Mich. App. filed Sept. 12, 1917. Headlights furnished with electric signals, controlled by the steering apparatus, to indicate direction of travel.

1,290,710. MAGNETO; John B. Bushnell, Vacaville, Cal. App. filed Dec. 14, 1917. Intensity of electromotive force generated by high-tension magnets generally constant.

1,290,711. SOUND RECORDING AND REPRODUCING MACHINE; Manuel Calderon, New York, N. Y. App. filed March 10, 1917. For moving-picture machines.

1,290,749. ADVERTISING LAMP AND RADIOMETER; Edward J. Hunt, West Orange, N. J. App. filed Nov. 8, 1917. Light from lamp filament causes rotation of motor vanes in bulb.

1,290,755. WIRELESS DETECTOR; Samuel S. Jones, Brooklyn, N. Y. App. filed Feb. 28, 1917. Removing crystal from holder to test for sensitive surface or other purposes unnecessary.

1,290,806. X-RAY APPARATUS FOR DENTAL USE; William H. Thwaites, Grand Rapids, Mich. App. filed July 2, 1917. Taking X-ray photographs facilitated and rendered harmless.

1,290,808. COMPOSITE RINGING APPARATUS; John F. Tommey, New York, N. Y. App. filed Oct. 30, 1917. For composite telephone and telegraph lines.

1,290,822. AUTOMATIC TELEPHONE SYSTEM; Charles S. Winston, Chicago, Ill. App. filed Dec. 26, 1911. Improved circuit arrangements of selector switches and improved line switch provided.

1,290,837. TELEPHONE SYSTEM; Alexander E. Keith, Chicago, Ill. App. filed Oct. 21, 1904. Of automatic type.

1,290,860. ELECTRIC FUSE; Allan P. Bender, Wilkinsburg, Pa. App. filed Dec. 5, 1914. Self-contained cartridge in which fuse element is mounted may be slipped into ordinary fuse casing and locked therein.

(Issued Jan. 14, 1919)

14,585 (reissue). POWER-LIMITING DEVICE; Harold D. Arnold, East Orange, N. J. App. filed Oct. 10, 1916. Polarized valve used in signaling systems.

1,290,863. TRIP-COIL-ADJUSTING MEANS; Chester D. Ainsworth, Wollaston, Mass. App. filed Jan. 4, 1918. Coils simultaneously adjusted for predetermined current flow.

1,290,868. MAGNETIC CHUCK; William Arter, Worcester, Mass. App. filed June 15, 1916. Requires few stock parts for different chucks.

1,290,881. ELECTRICAL GROUNDING DEVICE; Robert A. Becker, Poughkeepsie, N. Y. App. filed Nov. 27, 1916. Easily installed.

1,290,895. APPARATUS FOR SEPARATING AND RECOVERING DOMESTIC REFUSE; Daniel R. Bryan, Chatham, N. J. App. filed Nov. 21, 1916. Metallic particles removed.

1,290,899. ELECTRIC SWITCH; George A. Burnham, Saugus, Mass. App. filed Feb. 5, 1916. Handle detachable for use in manholes.

1,290,901. WATER-TIGHT ELECTRIC BELL MECHANISM; Paul C. Butte and Charles F. Butte, San Francisco, Cal. App. filed Jan. 17, 1918. Simple and compact.

1,290,902. ELECTRIC FURNACE; Charles A. Cadwell, Cleveland, Ohio. App. filed May 1, 1915. Operates on high-voltage current.

1,290,903. ELECTRIC WELDING APPARATUS; Charles A. Cadwell, Cleveland, Ohio. App. filed Nov. 25, 1916. In electric railway repairing uses energy directly from trolley wire.

1,290,908. VOLTAGE-REGULATING SYSTEM; Robert M. Carothers, Schenectady, N. Y. App. filed Feb. 14, 1917. Control dynamo is connected in series between load circuit and main source of energy.